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ASTM BULLETIN

JANUARY 1954

Number 195

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ASTM BULLETIN

"Promotion of Knowledge of Materials of Engineering, and Standardization of Specifications and Methods of Testing"

Number 195 **JANUARY, 1954**

Highlights of ASTM Committee Week, February 1–5, 1954

Hotel Shoreham, Washington, D. C.—41 Committees to Meet—Symposium on Design of Experiments—Symposium on Color of Translucent Products—Dinner

THERE is every indication that the 1954 Committee Week will be the largest in the Society's history. This can be attributed either to the location of the meetings—the country's capital being a favorite place—or to the fact that it is the first Committee Week that has been held as early as the first week in February rather than the usual meeting time of the first week in March. The reason for advancing this date has been to provide a greater interval between Committee Week and the Annual Meeting, thus providing committees with more time to prepare their reports for preprinting.

Committee Week

A total of 41 committees, with their subcommittees, will meet during the first week in February:

A-3 on Cast Iron
A-5 on Corrosion of Iron and Steel
A-7 on Malleable Iron Castings
A-10 on Iron-Chromium, Iron-Chromium-Nickel and Related Alloys
B-1 on Wires for Electrical Conductors
B-2 on Non-Ferrous Metals and Alloys
B-3 on Corrosion of Non-Ferrous Metals and Alloys
B-5 on Copper and Copper Alloys, Cast and Wrought
B-6 on Die Casting Metals and Alloys
B-7 on Light Metals and Alloys Cast and Wrought
B-8 on Electrodeposited Metallic Coatings
C-1 on Cement
C-2 on Magnesium Oxychloride and Magnesium Oxysulfate Cements
C-3 on Chemical-Resistant Mortars
C-7 on Lime
C-8 on Refractories
C-9 on Concrete and Concrete Aggregates
C-11 on Gypsum
C-12 on Mortars for Unit Masonry
C-15 on Manufactured Masonry Units
C-16 on Thermal Insulating Materials
C-18 on Natural Building Stones
C-19 on Structural Sandwich Constructions
C-22 on Porcelain Enamel
D-1 on Paint, Varnish, Lacquer, and Related Products
D-3 on Gaseous Fuels
D-4 on Road and Paving Materials
D-8 on Bituminous Waterproofing and Roofing Materials
D-11 on Rubber and Rubber-Like Materials
D-16 on Industrial Aromatic Hydrocarbons and Related Materials
D-19 on Industrial Water
D-21 on Wax Polishes and Related Material
D-22 on Methods of Atmospheric Sampling and Analysis
E-1 on Methods of Testing
E-4 on Metallography
E-5 on Fire Tests of Materials and Construction
E-7 on Non-Destructive Testing
E-9 on Fatigue
E-10 on Radioactive Isotopes
E-12 on Appearance
Joint Committee on Paint, Varnish and Lacquer

A feature of the D-1 meeting will be the presentation of the paper, "Photochemical Deterioration of Automobile Lacquers" by Roger Saur, General Motors Corp. This is scheduled on February 2 at 4 p.m.

Symposium on Design of Experiments

The Symposium on Design of Experiments is being sponsored by Committee E-11 on Quality Control of Materials. The following three papers will comprise the symposium:

The Purpose of Experimental Data—W. G. Cochran, Johns Hopkins University.
An Engineering Application of Experimental Design—Besse B. Day, and F. R. Del Priori, Naval Experimental Station.
Design of Experiments and Physical Sciences—W. J. Youden, National Bureau of Standards.

The Symposium will be held on Tuesday evening, February 2, and the presiding officer of the technical session will be W. R. Pabst, Jr., U. S. Department of the Navy.

Symposium on Color of Translucent Products

Committee E-12 on Appearance also will sponsor one of the features of the 1954 Committee Week; this being the Symposium on Color of Translucent Products to be held in two sessions on Wednesday morning and afternoon, February 3. The following seven papers comprise this symposium:

The Color of Petroleum Products—H. M. Hancock and J. J. Watt, The Atlantic Refining Co.
A Color Space for Color Grading Purposes—G. W. Ingle, Monsanto Chemical.
Color Problems in Glass Products—A. J. Werner, Corning Glass.
Color in the Brewing Industry—Irwin Stone, Wallerstein Laboratories.
Color Problems in Sugar Clarifinate—R. A. McGinnis, Spreckels Sugar.
Color Grading of Agricultural Products—Wilbur Gould, Ohio State University.
Color Problems in Transparent Surface Coatings
Color in Dairy Products—Mark Keeney, University of Maryland.
Summary and Open Discussion—Deane B. Judd, moderator.

Cocktail Party and Dinner

The Washington District of the Society is arranging a dinner, preceded by a social hour for Wednesday, February 3, at the Hotel Shoreham. The social hour will provide an opportunity to meet national and district officers.

ASSISTANT SECRETARY OF DEFENSE TO BE DINNER SPEAKER

We are pleased to announce that Mr. C. S. Thomas, Assistant Secretary of Defense (Logistics and Supply) will be the guest of honor and speaker at the Washington Dinner Meeting, Wednesday, February 3. Mr. Thomas' responsibilities cover activities in the Defense Department which are of direct concern to many of our members, and the standardization work which is in his department is related to various ASTM activities.

Other men in the Federal Government, both in civilian and defense departments, are being invited to the dinner.

Ladies invited **Informal**

NEW ASTM PUBLICATIONS

Toward Wider Use of Porcelain Enamel

In the engineering world of today, there are many applications where even the best of metals sometimes deteriorate quickly due to heat, abrasion, vibration, or contact with corrosive materials. For many of these applications ceramic coatings and porcelain enamels are being proved to offer the best all-around protection.

A new symposium on ceramic coatings and porcelain enamels is now available in published form. The symposium was planned and presented by Committee C-22 on Porcelain Enamels to give today's working engineer a wide-angle view of what can be done with such materials. Perhaps ceramic technology meant only pots, pans, stoves, and refrigerators to yesterday's engineers, but now it also means faster jet planes whose critical burner parts last longer though operating at higher temperatures though constructed with smaller amounts of today's rare strategic materials. It means longer-lasting porcelain enamel processing equipment which is resistant to alkalies as well as to acids and which turns out purer chemical products. Ceramic coatings are to some types of conveying equipment what recapping is to tires. These are just a few of the new meanings, from a specialized field, to our engineer. Now he is interested in even newer meanings—and these will depend on his knowing some of the ceramic terminology, the technology, present applications, and availability of materials. He wants to know who has found and who is developing new applications—how much progress there is, what are the forecasts on some of these? He wants to look the field over—he does not want to overlook it. This symposium has been profusely illustrated; it contains much valuable data on the mechanical properties of the porcelain and ceramic coatings. Price: $2.50; to members, $1.85.

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Electron Metallography

The electron microscope is a powerful tool for the investigation of submicroscopic structures. Its capabilities have been clearly demonstrated in numerous applications to a variety of research problems. In order to employ this instrument for the study of structures of opaque materials (metallurgical specimens) special techniques are needed. As in optical metallography, the structure is delineated by suitable etching methods. The etched structure is regenerated in an extremely thin "replica" that is transparent to the electron stream which constitutes the illumination. The replication process is necessarily complex and depends for its success upon critical attention to details of specimen preparation.

A symposium was presented at the 1952 Annual Meeting which had as its purpose to present examples of such techniques described above in common use or of potential value in the hope that increased interest in the application of electron microscopy to metallurgical problems would result. This symposium has now been published. In about a dozen papers comprising the symposium, techniques are discussed which are applicable to aluminum, precipitated carbides, steel, and iron. Techniques such as inorganic replication, extraction replica, silica and plastic replica, metal shadowing for contrast enhancement, specimen polishing and washing are covered in various papers. Unconventional etchants are described. Comparison has been made of positive *versus* negative plastic replicas.

Most of the papers are well referenced; there are numerous high-quality photomicrographs, and throughout the 152 pages there are numerous illustrations and diagrams.

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Gravity Conversion Wall Chart

Table 5 from the ASTM-IP Petroleum Measurement Tables (API Gravity Conversion to 60 F) is now available in wall chart form for convenience to the reader.

As published, the wall chart will consist of four separate 22 by 33-in. sheets. The four sheets cover the API Gravity Range 0–99°, 0–50°, 50–100°, 0–49°; for the respective temperature ranges 0.–50, 50–125, 50–150, 150–250 F.

Four sheets priced at 60 cents per sheet. Quantity prices available.

Calibrating Liquid Containers

ASTM has a new manual on calibrating liquid containers; it contains the necessary procedures of volume calculations for the accurate determination of the incremental and total capacities of liquid containers, mobile or standard, larger than a barrel or drum.

The manual was prepared by Section E of Committee D-2, Division II, which is representative of users, manufacturers, builders of such containers, as well as measurement inspection companies.

Accurate measurement of liquid in bulk is essential in nearly all cases. Since the storage of liquids requires suitable containers, it is usually convenient to obtain measurement of volume by measuring the depth of liquid contained in accurately calibrated tanks. Such calibration requires accurate measurement of dimensions and the calculation of incremental total capacity therefrom. This manual describes how to make such measurements.

The committee considered and followed, where practical, existing codes and manuals and other available data.

Part I contains procedures for accumulating field data for the determination of containers' volume and incremental capacity tables.

Part II contains methods for translating field data into finished incremental capacity tables.

Various industries such as the petroleum, paint, brewing and distilling, chemical, and food industries faced with such problems of liquid measurement should find this manual helpful. Containing 100 pages the manual costs $1; to members, 75 cents.

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Spectrochemical Analysis Index

Part III of a series of bibliographic surveys of the literature of spectrochemical analysis is now available. In preparing Part III, B. F. Scribner and William F. Meggers found a definite preference among users for the inclusion of abstracts, and accordingly (as in the first two parts) this practice has been continued. A detailed subject index is again provided, and in addition an author index is included. The abstracts in Part III are largely quoted verbatim from *Chemical Abstracts*, but occasionally they are abridged or quoted from other publications, or specially prepared. The index covers the years 1946 to 1950. Price: $4.50; to members, $3.40.

Materials Research, New Standards Keynote ASTM Work in 1953

The past year was not our fiftieth anniversary—actually it was the year after. Because of this we approached the task of reviewing the Society's activities for 1953 perhaps a little timidly, for subconsciously there was a feeling that 1953 might suffer in contrast to the glories of the fiftieth anniversary year, but as we scanned last year's BULLETINS, manuscripts, news releases, and other evidence of what was accomplished, this timidity disappeared.

Looking at the 1953 Annual Meeting in retrospect, there was much in it which represented significant achievement. Perhaps not statistically according to attendance and similar records of the Annual Meeting, but in technical accomplishments the year is a noteworthy one. The review is accordingly devoted to the symposiums which were presented, mentioning some of the outstanding papers, our distinguished members who were honored, our Marburg and Gillett lecturers, and our standards accomplishments of the year.

Symposiums

We are proud that last year a portion of the total ASTM effort was spent on the as yet unsolved problems of soil dynamics. Committee D-18 on Soils sponsored and presented a Symposium on Soil Dynamics which discusses these problems and provides assembled information which will serve as a point of departure for future work aimed at a solution.

Also light was thrown on a much discussed and highly controversial problem in the field of foundation engineering—the behavior of piles. Again it was Committee D-18 which presented a Symposium on Lateral Load Pile Testing. There was keen interest in the presentation and discussion of the papers of this symposium on a subject which heretofore has been characterized by the lack of relative data.

Today's jet planes fly faster and faster ... to do this the operating temperatures of their burners go higher and higher. In turn, this means that the parts that make up these burners must be built to withstand these higher temperatures. Only those alloys which contain some of our most strategic critical additives, in the past, filled these requirements. But now it is being shown that ordinary carbon steel alloys in some instances can be coated with porcelain or ceramic type films and because of these films meet the higher temperature requirements.

Also steel chemical processing vessels of today can be coated with these glass-like materials which have been developed to the point where they are *resistant to alkalies* as well as acids. From the chemical processor's viewpoint this fact is of tremendous significance in terms of capital investment for processing equipment.

Because of recent developments that have occurred in the porcelain enamel field, Committee C-22 sponsored a symposium planned to interest the many engineers now concerned with the work but not associated with the porcelain enamel of ceramic coating fields. The symposium presented data on the mechanical properties of these materials and indicated the trend of future development.

Knowledge on the behavior of metallic materials at low temperatures is becoming increasingly important as our trucks, ships, and planes are subjected to more severe operating conditions. Realizing this, the low-temperature panel of the ASTM-ASME Joint Committee on the Effect of Temperature on the Properties of Metals sponsored another piece of important work. Its symposium evaluated engineering failures at low temperatures, established criteria for design engineers, and discussed the significance of notch toughness tests on metals at the lower temperatures.

In discussing last year's important symposiums we would be remiss in not mentioning the symposiums on Electron Metallography Techniques and on X-ray Spectrography. Both of these are coming into their own as powerful tools in the search for the answer: Why do materials behave as they do?

Technical Papers—Awards

In addition to those of the symposiums, there were many technical papers accepted by the Society last year for publication. Obviously, all of them could not win a Society award but they all filled some definite need in one of the fields of the Society's work. Each one represents the best creative scientific thought in some materials field.

Many of these technical papers filled our BULLETIN pages last year; many others are being assembled now in the 1953 *Proceedings*. In the aggregate they represent one of the most important Society efforts of 1953.

The Dudley Medal went to Davis and Manjoine for their work on notch geometry—its effects on elevated temperature rupture strength of metals. Professor Findley and his associates were recipients of the Templin Award for a paper on a fatigue machine for testing specimens at low temperatures. The Sam Tour Award was given to J. R. McDowell for his work on fretting corrosion. Mrs. Katharine Mather won the Sanford E. Thompson Award for her work, the utilization of the microscope in concrete research.

Marburg Lecture

The Society was fortunate last year in being able to bring Frederick D. Rossini before the ASTM members. It is hard to overestimate the effect of Dr. Rossini's fundamental work in Thermodynamics on the world's progress in solving the mysteries of energy. Dr. Rossini paid honor to our Society's first Secretary, Edgar Marburg and at the same time recorded some of his valuable experience in petroleum technology in his lecture "An Excursion in Petroleum Chemistry."

Gillett Lecture

Our knowledge of the sometimes tremendous effects on the properties of metals that result from only minute additions of elements was significantly increased when Jerome Strauss made a comprehensive review of these minute additions. He poured his many years of intimate connection with this work into a lecture by which the Society honors his late contemporary, Horace Gillett.

Honorary Members—Forty and Fifty Year Members

Tribute was paid last year to two members who have contributed significantly to the work of the Society for many years. Honorary Membership, the Society's most signal honor, was bestowed on Horace H. Lester, and posthumously on Lloyd B. Jones.

Members active in the Society's work for forty years and for fifty years

were also honored. These were too many to list in this brief outline, but we will mention one of the fifty-year members: Professor Herbert F. Moore, of the University of Illinois. He has contributed much to the Society; he is well known for his classic textbook on Engineering Materials; he is one of the foremost men in the materials field, and an Honorary Member of the Society.

Publications

Publishing of papers presented at the Society's various meetings or accepted by our Committee on Papers in itself is an important yearly task. In addition to the symposiums which are published as special technical publications, and the technical papers which are included in the BULLETIN or *Proceedings*, there are many other "jobs" to print and distribute each year.

Although last year was not a Book of Standards Year, there were numerous compilations of related standards, supplements, charts, tables, and prospectuses printed. News of the Society which amounts to about one third of our ASTM BULLETIN was disseminated. Besides reports on meetings, new standards, and members, important articles were published on some of the Society's "sidelight" programs. These latter dealt with corrosion, wood pole testing, the broad use of ASTM standards and simulated service and nondestructive testing. Everything the Society does appears in one printed form or another.

Standards and Other Technical Activities

Last year at the Spring Meeting, the Annual Meeting, and numerous other meetings scattered over the United States, standards work of the Society was reported in all of its many fields. In the remaining paragraphs, a summary of the more important work of most of our committees has been included. One of the more outstanding jobs was the completion of an extensive compilation of methods for emission spectrochemical analysis by Committee E-2.

ASTM Technical Committees

A-1 Steel

A project discussed in Committee A-1 for years, started in 1950, and planned for completion in 1955, reached fulfillment in 1953 because of extraordinary efforts on the part of many members of the committee. The Tentative Methods and Definitions for the Mechanical Testing of Steel Products (A 370 – 53 T) represents a coordination of many divergent views on the production testing of steel products. The present document includes a general section covering procedures and definitions applicable to all steel products, and two supplements covering specific procedures for bar products and tubular products. An additional supplement covering testing of bolting is expected to be added in 1954.

Another project of importance to the power industry reached its final stage in 1953 with the publication of the Tentative Specifications for Ferritic Alloy Steel Forged and Bored Pipe for High-Temperature Service (A 369 – 53 T). The term "pipe" as used in these specifications covers pipe, headers, and leads.

A-3 Cast Iron

Two methods of determining the chilling tendencies of cast iron have been covered in the Tentative Methods of Chill Testing of Cast Iron (A 367 – 53 T). The methods apply to gray irons which are to be free of chill in the casting and to chilled irons which are to have a specified depth of chill in the casting.

A-5 Corrosion of Iron and Steel

An important new tentative specification was promulgated by Committee A-5 during the year, namely, Tentative Specifications for Zinc-Coated Steel Overhead Ground Wire Strand (A 363).

The biennial report of Subcommittee XV on Atmospheric Exposure Tests of Wire and Wire Products (appended to the annual report of A-5) presents in detail the data from the 1951 and 1952 inspections. These wire tests at each of the different sites have been on exposure for 16 yr.

Although there was no interim report this year from the hardware subcommittee, it is of interest to note that the questionnaire which was sent out to the A-5 membership was responsible for the subcommittee's plan to inaugurate a new series of hardware tests.

A-9 Ferro-Alloys

Because of the character of most of the available manganese ore, it has become extremely difficult to meet the 78 to 82 per cent manganese requirement in the standard grade of the Ferromanganese Specifications A 99. Another grade has been agreed upon requiring 74 to 78 per cent manganese and 7.5 per cent maximum carbon. This has been published in the Tentative Specification for Ferromanganese (A 99 – 53 T).

A-10 Iron-Chromium, Iron-Chromium-Nickel and Related Alloys

After several years in preparation, Committee A-10 completed and presented to the Society through the Administrative Committee on Standards the Tentative Specifications for Iron-Chromium and Iron-Chromium-Nickel Alloy Tubular Centrifugal Castings for General Applications (A 362). The Society at the Annual Meeting accepted the Tentative Specifications for Stainless Steel Wire Strand (A 368), this specification covering stainless steel strand suitable for use as guy wires, overhead wires, and similar purposes.

A paper by M. A. Streicher which appeared in the February, 1953, ASTM BULLETIN, "Screening Stainless Steels from the Nitric Acid Test by Electrolytic Etching in Oxalic Acid," was the basis of a considerable amount of work on both wrought and cast stainless steel alloys comparing the etching technique as outlined in this article with the results of the standard boiling nitric acid test. This work has been completed and the results appear in this issue of the BULLETIN; see p. 63.

Subcommittee VI on Metallography has published in the A-10 Report the results of its work on metallographic techniques for identification of sigma phase in austenitic chromium-nickel steels. These data and discussion thereof are being published in the 1953 *Proceedings*.

B-1 Wires for Electrical Conductors

The Tentative Specifications for Soft or Annealed Copper Wire (B 3 – 53 T) now include sampling procedures based on statistical analysis of data collected for this purpose. Both Specifications B 3 and Specifications B 1 for Hard-Drawn Copper Wire contain this new approach to sampling.

After several years of development, the Tentative Method for Determination of Cross-Sectional Area of Stranded Conductors (B 263 – 53 T) has been published, covering the weight method.

For many years there has been need for industry standardization on stiffness requirements for soft copper wire, particularly as applied to magnet wire, as evidenced by the development of many special test methods by individual users (Morehouse, RCA, Belden, LSE, Rockwell Superficial, etc.). The committee has considered this problem over

the years but has been unable to establish one method as being applicable for all requirements. Therefore, in order to provide a start in this direction, it has limited its present consideration to a narrower scope covering only bare soft square and rectangular copper wire. The Tentative Method of Test for Stiffness of Bare Soft Square and Rectangular Copper Wire for Magnet Wire Fabrication (B 279 – 53 T) covering the LSE test was published in 1953.

B-5 Copper and Copper Alloys, Cast and Wrought

Committee B-5 has promulgated two new specifications as a result of intensive committee deliberations. These are the Tentative Specification for Seamless Copper Tube for Refrigeration Field Service (B 280 – 53 T) and the Tentative Specification for Copper and Copper-Alloy Die Forgings (Hot-Pressed) (B 283 – 53 T).

Specification B 280 covers type DHP, DLP, or OF copper tube in coils intended for use in the field for connection, repairs, and alterations.

Specification B 283 includes forging brass, naval brass, leaded naval brass, 45–10 nickel silver, manganese bronze, aluminum-silicon bronze, copper, and high-silicon bronze.

B-6 Die-Cast Metals and Alloys

The results of 5-yr exposure of aluminum die-casting alloy G8 and SG100A at Sandy Hook, N. J., and New York City are appended to the 1953 B-6 report. A new series of exposure tests on aluminum alloy SC84 has been initiated at the 80- and 800-ft test sites at Kure Beach, N. C., New York City, and Columbus, Ohio, for 1-, 3-, 6-, and 12-yr periods.

There is also appended to the 1953 annual report of Committee B-6, the results of a series of tests to study the effect of zinc content on the mechanical properties of the SC84A aluminum die-casting alloy.

B-7 Light Metals and Alloys, Cast and Wrought

No new standards were submitted by the committee during the past year, but revisions were made in a number of the standards sponsored by the committee. In the majority of the cases revisions were intended primarily to broaden the scope of existing standards. For example, a number of new alloys have been added to the magnesium sand casting specification, the wrought magnesium specification, and magnesium extruded tube specification. A new alloy GS40A, a 3.5 per cent magnesium aluminum alloy, was added to a number of the aluminum specifications. The Tentative Recommended Practice for Codification of Light Metals and Alloys (B 255) was expanded, adding the symbol Y for the element antimony.

B-8 Electrodeposited Metallic Coatings

Subcommittee II on Performance Tests published another interim report (the first since 1951) reporting the exposure data on (1) copper-nickel-chromium deposits on high-carbon steel, (2) lead coatings on steel, and (3) methods of rating. The copper-nickel-chromium panels had been on exposure for 5.2 yr and the lead panels for 8.5 yr. In addition to the revision of tentative specifications and adoption of tentative specifications as standard, the committee recommended for Society approval the Tentative Recommended Practice for the Preparation of Copper and Copper-Base Alloys for Electroplating (B 281).

B-9 Metal Powders and Metal Powder Products

Very definite progress in the field of standardization of metal powders and metal powder products has taken place in Committee B-9 during the past year, although the Tentative Specifications for Sintered Metal Powder Structural Parts from Brass (B 282 – 53 T) has been the only new standard published by the Society.

A new Section IIB on Refractory Metal Powders has been organized. It was decided that the time is appropriate to start work on standard methods for testing tungsten and molybdenum powders.

Numerous standardization projects are under way and three standards are now in their final stages: (1) a method for subsieve particle size testing, (2) specifications for copper infiltrated iron parts, and (3) a recommended practice for hardness testing of cemented carbides.

C-1 Cement

The significant development in the cement field during the past year was the completion of a proposed specification for portland-pozzolan cement. This specification will include requirements for the use of fly ash, which has been receiving considerable attention in recent years. The old Standard Specification for Natural Cement (C 10 – 37) has now bowed out after long years of service in favor of a completely new specification which was published as a tentative specification in 1952 (C 10 – 52 T).

After long and extensive studies, mechanical mixing of standard test mortars was recognized through the acceptance by the Society of a Tentative Method for Mechanical Mixing of Hydraulic-Cement Mortars of Plastic Consistency (C 305). This will affect other existing ASTM test methods, all of which are now being scrutinized in respect to possible revision to incorporate mechanical mixing in place of hand mixing.

A soundness requirement has now been included in the Standard Specification for Masonry Cement (C 91) as a tentative revision, allowing an expansion of not more than 1 per cent when tested in accordance with the autoclave expansion method (C 151).

A proposed specification for slag cement was prepared during the year, but further study is required in order to obtain complete agreement. Reports were received on several round-robin test projects, including a study of apparatus and methods used in determining entrained air in standard mortar and the study of the significance of results on sulfate resistance. There was much progress on other projects in flame photometry, time of setting, heat of hydration, fineness, and SO_3 content.

C-2 Magnesium Oxychloride and Magnesium Oxysulfate Cements

The past year has been one of progress rather than completion of any particular project. The remaining tentatives under the jurisdiction of the committee were adopted as standard, these being specifications for magnesium chloride (C 276) and for magnesium sulfate (C 277). Study has been given to the development of a shear test, determination of wear of oxychloride cement compositions, a water resistance test of compositions, and the use of an autoclave test to determine soundness of oxychloride cement compositions.

C-3 Chemical-Resistant Mortars

Three new tentative methods of tests were accepted by the Society in 1953. These methods provided means for determining compressive strength (C 306), tensile strength (C 307), and working and setting times (C 308) of resin type chemical-resistant mortars. A draft of a proposed method for determining bond strength has now been

accepted preparatory to letter ballot action. A proposed tentative method of test for chemical resistance of resin type chemical-resistant mortars was also completed but still requires final committee acceptance.

C-4 Clay Pipe

A new field has been covered by the acceptance of Tentative Specifications for Clay Flue Linings (C 315). These specifications include the several commonly used shapes and sizes, such as round, rectangular, modular, and nonmodular sizes. All existing tentatives under the jurisdiction of the committee have been recommended for adoption as standard, with the exception of the Specifications for Extra Strength Clay Pipe (C 200), which is undergoing revision. Considerable progress has been made in the study of the effect of rate of loading on the ultimate strength of clay pipe, but no recommendations were made for revision of the present specification requirements.

C-7 Lime

The development of an adequate expansion test for hydraulic lime was considerably advanced during the year, with a current cooperative test program under way to reconcile differences of opinion in comparing cement with gypsum as a basis for an autoclave test. A specification for lime for soil stabilization was completed. However, further revisions have been suggested by the Joint D-4, D-18 Subcommittee on Soil Stabilization. Further significant changes were agreed upon in the Tentative Specification for Mortar for Unit Masonry (C 270). This specification is under the joint jurisdiction of Committees C-7 and C-12 on Mortars for Unit Masonry. The changes involve the use of admixtures, the priority of the proportion specification when otherwise not stated, and a change in the designation of the several mortar types.

C-8 Refractories

A Tentative Classification for Single and Double-Screened Ground Refractory Materials (C 316) was accepted by the Society through the Administrative Committee on Standards. The first group of tests on a study of methods for determining the bulk density of refractory grains has been completed, the results indicating disagreement between laboratories and suggestions for improvement of the tests, in order to arrive at a single procedure. Significant progress has been made in the field of special refractories. The acceptance of definitions for "mullite refractories" and for "silicon carbide refractories" will now enable more progress to be made in establishing standards on this type of refractory. A proposed method of chemical analysis for silicon carbide refractories was completed but has not yet been presented to the committee for acceptance. A proposed outline was accepted by the committee for an enlarged and revised section in the refractories manual, presenting suggested microscope techniques for the study of refractories. Considerable attention was given to standards for carbon refractories during the past year, with a subcommittee actively studying several test methods which will measure reheat, load, thermal conductivity, permeability, and oxidation.

C-9 Concrete and Concrete Aggregates

The use of fly ash as an admixture for portland-cement concrete received considerable attention during 1953, resulting in the acceptance by the Society of a tentative method of test (C 311). A proposed specification on fly ash also reached final stages of development. The last of a group of four freezing-and-thawing test methods was also accepted by the Society. This method (C 310) involves slow freezing in air and thawing in water. A tentative specification for liquid membrane-forming compounds for curing concrete (C 309) was accepted. This specification consists of four general types suitable for spraying on horizontal and vertical concrete surfaces to retard the loss of water during the early hardening period. A method for determining the potential volume change of cement aggregate combinations was prepared following the completion of an extensive cooperative series of tests to study various methods. Considerable attention was given to a study of tamping rods and the effect of capping of cylinders on the concrete strength. Volume change of concrete products can now be determined by a proposed tentative method which was completed. However, a revised draft is now being prepared for letter ballot.

Three separate specifications were prepared for lightweight aggregate. Specifications for use in structural concrete and in concrete units respectively have been accepted by the Society. A third specification for use in insulating concrete was accepted by subcommittee and will be presented to the committee in the near future. These three specifications will replace the existing Standard Specifications C 130. The third cooperative series was completed on several types of abrasion or wear testing apparatus, with the result that further evaluation will be limited to two types of apparatus, namely, the dressing wheel and the sand blast. A new test series has been inaugurated. Considerable data were collected in a cooperative series among several laboratories evaluating the setting times of a standard air-entrained concrete mix and with this mix modified by the addition of a specified amount of a nonproprietary accelerator or retarder.

C-11 Gypsum

Two new specifications were accepted by the Society during 1953, which, together with the several existing specifications, provide a rather complete coverage in the field of gypsum materials and products. A specification for gypsum formboard provides requirements for use in connection with poured-in-place reinforced gypsum concrete roof decks. The second specification covers mill-mixed gypsum concrete, consisting essentially of calcined gypsum and suitable aggregate requiring the addition of water only at the job. This concrete is intended for use in the construction of poured-in-place roof decks or slabs. An alcohol wash method of sieving gypsum and gypsum products was agreed upon for incorporation into the Standard Methods of Testing Gypsum and Gypsum Products (C 26). This method provides for a long needed means of determining fineness, because it has been impractical to sieve dry gypsum and water cannot be used as a washing agent. Several other revisions in Methods C 26 have been agreed upon for further refinement of these determinations. Revisions were accomplished in the Specifications for Inorganic Aggregates for Use in Interior Plaster (C 35) which will further improve the sieve analysis of perlite and change the minimum weight of vermiculite aggregate.

C-12 Mortars for Unit Masonry

Further revisions in the Specifications for Mortar for Unit Masonry (C 270) were accomplished, in joint agreement with Committee C-7 on Lime. (Details on these changes are noted in the Committee C-7 review.) A report was prepared on the use of efflo wicks for determining efflorescence, which is now being reviewed for publication in the ASTM Bulletin. This report embodies the results of cooperative studies sponsored by the committee.

C-13 Concrete Pipe

A number of revisions were made during the year which are common to the four specifications for concrete pipe under the jurisdiction of the committee. Several of the significant changes include provision in pipe sizes exceeding 72 in. internal diameter for the strength test requirements to be based on specific design of the unit; provision for lift holes; the use of drilled cores in place of rodded cylinders to determine compressive strength of concrete in reinforced pipe; an extension of the permeability test period beyond 15 min and not to exceed 24 hr; and provision in the tables for nonreinforced concrete sewer pipe to contain values for extra strength pipe, as well as to recognize the use of tongue and groove type. Action was also taken to provide in Specifications C 14, C 75, and C 76 for allowable variations in squareness of pipe ends. A first draft was completed of a specification for low-head reinforced-concrete pressure pipe and for low-head reinforced-concrete sewage force mains, both of which drafts require further review. Recognition was made of the need for a specification for pre-cast concrete manhole sections for nonpressure pipe lines.

C-14 Glass and Glass Products

The versene method for titration of lime and magnesia in the analysis of soda-lime glass has been prepared in draft form for inclusion in ASTM Method C 169. This method will also be used in connection with the chemical analysis of glass sand (C 146). A complete revision of the routine procedure for determination of boric oxide in Method C 169 was adopted by the Society at the Annual Meeting. Rapid routine methods for glass sand analysis were also prepared for committee letter ballot. Proposed methods of testing the softening point and average linear expansion of glass have been completed and are in process of committee letter ballot. The determination of strain point and annealing point has also been prepared in draft form and is now being reviewed.

C-15 Manufactured Masonry Units

The matter of sulfur capping *versus* cement-gypsum or plaster-of-Paris capping received considerable discussion during the past year in relation to the difference in effect upon the compressive strength tests of concrete masonry units. Efforts will be made to collect all data available on the subject for further study. Recognition of single cell load-bearing clay wall tile was made in a revision of ASTM Specification C 34. The completion of a study of a new type of unit now referred to as a brick-block unit has resulted in the recognition of a need for an ASTM standard for this type of unit, and work has been in progress for this purpose. Consideration was also given to the expansion of the scope of Committee C-15 to include waterproofing materials for unit masonry.

C-16 Thermal Insulating Materials

Two new projects were inaugurated in 1953 by Committee C-16, in addition to completion of several proposed tentatives which were accepted by the Society. A research project to determine the effect of moisture on thermal conductivity is under way at Pennsylvania State University. An expansion of the scope of the committee led to the organization of a new subcommittee, which will determine the physical properties of coatings other than permeance. Exploratory tests are already under way on flame propagation tests. A Tentative Recommended Practice for Clearance of Preformed Thermal Pipe Insulation (C 312), accepted by the Society, provides a control of clearances between the outside of pipe and tubing and the inside of insulation as applied to temperatures not over 600 F. Tentative specifications for 85 per cent magnesia thermal block insulation (C 319) and for pipe insulation (C 320) were also accepted for publication. Similar specifications for block and pipe involving diatomaceous earth insulation were completed and accepted by the Administrative Committee on Standards. A significant accomplishment was the final acceptance of a proposed tentative method of test for thermal conductivity of pipe insulation. With the acceptance of this test method, the committee now has rather complete coverage in the field of thermal conductivity determination, represented by the guarded hot plate method (C 177), the guarded hot box method (C 236), and now the method for pipe insulation. Much consideration was given during the past year to the development of a suitable method for determining flame resistance. Several test methods were prepared in final form for letter ballot covering such special thermal properties as specific heat, maximum use temperature limit, and emissivity. A fifth draft of a proposed method for determining water vapor transmission of materials used in building construction was completed and accepted. The need for a common method of sampling of all types of thermal insulation materials resulted in the preparation of a proposed method, which is now ready for letter ballot.

C-17 Asbestos-Cement Products

The activity of Committee C-17 during the past year was mainly in evaluating the test methods that are now incorporated in the present specifications and in the preparation of significance of test statements which have now been included in the ASTM tentatives in this field. The study of handleability of asbestos-cement products has also been under way for the purpose of developing test methods for determining this property.

C-18 Natural Building Stones

The need for specifications on the several types of natural building stones received much consideration by Committee C-18. However, the need for extensive research leading to the development of standard test methods has been very much in evidence and has thus prevented the actual development of these specifications. The committee is awaiting with interest research at Mellon Institute, sponsored by the marble producers. Revisions of the Tentative Method of Test for Durability of Slate for Roofing (C 217) were studied. Attention was given to further definitions of terms, especially an attempt to describe texture.

C-19 Structural Sandwich Construction

Test methods on core materials, as well as on the complete sandwich construction, were prepared and are now being circulated for committee action. In respect to core materials, the proposed methods prepared evaluate compressive and shear properties, a heat distortion test method having received preliminary consideration. Proposed methods for measuring flexure and peel on the complete sandwich construction are the other methods which have been circulated. Progress was made in plans for establishing weathering panels for observing the durability and aging effects, possibly making use of ASTM test sites.

C-20 Acoustical Materials

The fruits of research and development activities, not only for the past year, but since the organization of this new committee, bore definite results in 1953 in the form of several proposed test methods and one specification, which are now at the point of being

considered and accepted by Committee C-20. For more complete information on these developments, see page 26 of this BULLETIN covering the recent meeting of Committee C-20.

C-21 Ceramic Whiteware

Eight proposed tentative methods of tests were presented to the Society for acceptance near the end of the year. These represent the first group of methods in the ceramic whiteware field which will be published under ASTM designations. They include chemical analysis, wet sieve analysis, free moisture content, drying and firing shrinkage, and a sampling method of whiteware clays. The remaining three proposed methods include the determination of modulus of rupture of fired dry pressed whiteware specimens at normal temperature, true specific gravity of fired whiteware materials, and the determination of linear thermal expansion of whiteware products at temperatures lower than 1000 C by the interferometric method. A considerable group of definitions of terms, as well as revisions of existing terms were considered, and agreement was reached on a number of these. A research investigation of methods to determine subsieve particle size was launched with thirty-eight laboratories agreeing to participate, of which twenty-three reported results on a selected sample of clay. Eleven methods of measurement were used. From these data, correlation will be made in an attempt to arrive at one suitable method.

C-22 Porcelain Enamel

One of the major accomplishments of the committee was the sponsoring and presentation of a Symposium on Porcelain Enamels and Ceramic Coatings as Engineering Materials. Sixteen papers were included in the symposium presenting interesting information and data on a number of important but diversified fields to which these coatings are particularly adapted, including in particular the use of ceramic coatings when exposed to high temperatures such as those occurring in jet engines. This symposium, *Special Technical Publication No. 153*, is now available. Two new tentative methods were accepted by the Society, providing procedures for measuring adherence of porcelain enamel and ceramic coatings to sheet metal (C 313) and warpage of porcelain enamel flatware (C 314). There was much activity in developing additional test methods, both on raw materials, as well as on finished products. Those methods nearest completion include water analysis and clay slump test on raw materials, coefficient of scatter and reflectivity in the field of finished products. Other test methods which received attention include abrasion, thickness, scratch, continuity of coating, and metal marking. Data were collected on a proposed sag test. (More details of committee activity can be found in the December, 1953, issue of the ASTM BULLETIN, p. 21.

D-1 Paints and Related Materials

The first standards for glycerin used in the manufacture of alkyds and other synthetic resins were completed this year by Committee D-1. These included purchase specifications and methods for sampling and testing procedures for specific gravity, color, appearance, odor, sulfate ash, and acid value. An important revision was made in the Tentative Method of Test for Specular Gloss (D 523) which was revised to cover comparisons of gloss with 20-deg and 85-deg geometry in addition to the 60 deg formerly covered. This enlarged scope of the method will make it more useful for gloss determinations.

The cooperative work with the Federation of Paint and Varnish Production Clubs continued quite active, resulting in the approval by the Federation of several additional ASTM test methods. This brings the total to 52 standards approved by both the Federation and the ASTM comprising 21 specifications and 31 methods of test.

The procedures for the chemical analysis of lead pigments covering both basic carbonate and basic sulfate lead were extensively revised and brought up to date and issued under the designation D 1301 – 53 T. Several new test methods completed and issued as tentative, covered Nonvolatile Content of Resin Solutions (D 1259), Method for Calculating Small Color Differences (D 1260), Test for Residual Odor of Lacquer Solvents and Diluents (D 1296), and Test for No-Dirt Retention Time of Traffic Paint (D 1297).

Two methods published as information only covered Test for Viscosity Reduction Power of Hydrocarbon Solvents, and a Revised Test for the Tag Open Cup Flash Point of Volatile Flammable Materials.

D-2 Petroleum Products and Lubricants

Probably the outstanding accomplishment by Committee D-2 this year was the recalculation of the ASTM Viscosity Tables for Kinematic Viscosity Conversions and Viscosity Index Calculations. The new tables were made necessary by the adoption on July 1, 1953, of a new value of 1.0038 cs at 68 F as the standard value for the kinematic viscosity of water. This resulted in a reduction of 0.318 per cent in the kinematic viscosity of a given product. The tables cover viscosity conversion at 100 and 210 F. For convenience in converting kinematic viscosities to Saybolt universal viscosities at other temperatures, a new table of factors was prepared for viscosity conversions in the temperature range from −100 to +500 F.

Another important accomplishment was completion of the revised Method of Test for Kinematic Viscosity (D 445) including the addition to the method in a series of appendices of detailed descriptions of nine different types of viscometers that are known to meet the precision requirements in Method D 445.

The ASTM-IP Petroleum Measurement Tables, developed last year jointly with the Institute of Petroleum (London), continued in widespread demand. Because of the variety of uses of the tables throughout the petroleum industry, the individual tables from the American Edition were made available in separate pamphlet form. The tables appearing in *Circular C 410* of the National Bureau of Standards were withdrawn on January 1, 1954, and are superseded by the ASTM-IP Petroleum Measurement Tables.

An important addition to the Tentative Specifications for Aviation Gasoline was the inclusion of requirements for a new Grade 108-135. This grade which will be largely used by commercial airlines is colored brown for identification. Maximum and minimum standard color samples for Grade 108-135 were also prepared and made available from Society Headquarters. The Tentative Specifications for Gasoline (D 439) were also revised. The minimum research octane number for premium grade gasolines was increased from 85 to 86, based on information reported in the 1952–1953 Winter National Motor Gasoline Survey.

An important revision in the Motor Method (D 357) and in the Research Method (D 908) for Determining Knock Characteristics of Motor Fuels was the elimination of the bouncing pin, effective January 1, 1954. After this date the Detonation Meter will be used in both methods for measuring the knock intensity.

The Test for Saybolt Color of Refined Petroleum Products by Means of Saybolt Chromometer (D 156) was exten-

sively revised. Several new methods for greases were issued as tentative covering tests for Effect of Grease on Copper (D 1261), Leakage Tendencies of Wheel Bearing Greases (D 1263), Water Washout Characteristics of Greases (D 1264), and Lead in New and Used Greases (D 1262). Three new methods were issued for liquefied petroleum gases covering Sampling Procedures (D 1265), Tests for Vapor Pressure (D 1267), and for Sulfur by the CO_2-O_2 Lamp Method (D 1266).

An extensive summary of the activities of Committee D-2 during the past year was published in the December, 1953, ASTM BULLETIN, page 29.

D-3 Gaseous Fuels

Committee D-3 completed this year a new Method for Analysis of Carbureted Water Gas by the Mass Spectrometer (D 1302). This method is a companion standard to the present Tentative Method for Analysis of Natural Gases and related Types of Gaseous Mixtures by the Mass Spectrometer (D 1137).

In cooperation with Committee D-2 there was also prepared a Tentative Method of Sampling Liquefied Petroleum Gases (D 1265). This includes procedures for obtaining representative samples of propane, butane, or mixtures thereof in containers other than used in laboratory testing apparatus.

D-4 Road and Paving Materials

No new methods of tests or specifications were recommended by Committee D-4 during 1953, which marked a period of further refinement of existing standards. A number of revisions were presented to the Society, including changes in the definitions of such basic terms as slag, asphalt, pitches, and tar. Revisions were also made to the Specification for Bituminous Mixing Plant Requirements (D 995); the addition of two gradings to the Deval abrasion test method (D 289); and revision of the distillation test method for tars and tar products (D 20) and for cut-back asphaltic products (D 402). Fundamental studies were continued on triaxial testing in cooperation with the Triaxial Institute. Three methods for measuring angularity of sand were reviewed, these being based on the slump of cone, the void content of a closely graded size, and screening through slotted testing sieves. The measurement of skid resistance of portland cement mortar surfaces was given attention. A questionnaire was prepared in cooperation with Committee C-9 on Concrete and Concrete Aggregates to be sent to the various state highway departments and others, to establish the use of test methods relating to the structural properties of mineral aggregates. An extensive series of cooperative tests to develop a method to measure the curing properties of asphaltic cut-back materials was completed, but further work is necessary on this difficult problem. The investigation of possible methods of evaluating the performance of bituminous coatings on aggregates in the presence of water was continued. During the year the application of a radioactive tracer technique to the measurement of "stripping" was studied and further investigation seems warranted. A study of the Standard Specifications for Emulsified Asphalt (D 977) was in progress with a view to reducing the number of types and simplification between types. Proposed specifications for aggregates for use in single and multiple-surface treatments, as well as a recommended practice on the use of materials in surface treatment, was prepared but further review is required.

D-5 Coal and Coke

The Method of Sampling and Analysis of Coal for Volatile Matter Determination in Connection with Smoke Ordinances (D 980) was adopted as standard this year on the recommendation of Committee D-5. This method is rather extensively used in connection with smoke abatement programs in various sections of the country.

Committee D-5 completed plans for sponsoring a Symposium on Coal Sampling at the 1954 Annual Meeting of the Society to be held in Chicago, in June, 1954.

This committee has continued active participation in the work of the International Committee ISO TC/27 on Solid Mineral Fuels. A paper on current ASTM work on coal sampling was presented by W. M. Bertholf, chairman of the Mechanical Sampling Section of D-5, at a meeting of the ISO committee in London in October.

D-6 Paper and Paper Products

At the Annual Meeting in June, 1953, the Tentative Method of Test for Dimensional Changes of Paper with Changes in Moisture Conditions was presented to the Society and accepted as D 1270 – 53 T. Also, complete revision of the Tentative Method of Test for Moisture in Paper, Paperboard, and Paperboard and Fiberboard Containers was accepted.

New developments in process include a specification for paper for multiwall shipping sacks, and a general sampling method for paper and paper products.

D-7 Wood

The Wood Pole Research Program was actually inaugurated during the year by Committee D-7 at the Forest Products Laboratory. This program is a very comprehensive one, set up on a basis of a two-year project and has involved the solicitation of funds to the extent of $150,000 from the various producer and consumer interests, a good portion of which has been subscribed. The series will involve hundreds of tests of full size poles and thousands of tests of small clear specimens, with possible savings to the industry conservatively estimated at $1,000,000 a year. Special literature is available at Headquarters on the details of this test series. Additional coverage in the field of wood preservatives was accomplished through the acceptance of four new tentatives: a specification and method of chemical analysis of copperized chromated zinc chloride (D 1271 and D 1273) respectively; a specification and method of chemical analysis of pentachlorophenol (D 1272 and D 1274) respectively. In addition, the Standard Specifications for Creosote (D 390) and for Creosote-Coal Tar Solution (D 391) were completely revised. Significant changes were made and accepted by the Society in the Tentative Specification for Round Timber Piles (D 25), involving circumferences and diameters, cutting and trimming, and peeling. A draft of a specification for compreg (a resin-impregnated compressed wood), together with applicable methods of tests, was prepared and further revision is required. A new Subcommittee on Structural Fiberboards was organized and held its first meeting. Its initial efforts will be directed toward the development of standard definitions of terms relating to fiberboards, with the main activity concerned with the strength and mechanical properties of fiberboards.

D-8 Bituminous Waterproofing and Roofing Materials

Refinement of existing standards, rather than the completion of new standards, was the main accomplishment of Committee D-8 during the past year. These revisions affect the Specifications for Asphalt Roofing Surfaced with Mineral Granules (D 249), the Specifications for Asphalt Roofing Surfaced with Powdered Talc or Mica (D 224), and Specifications for Wide Selvage Asphalt Roofing Surfaced with Mineral Granules (D 371). A proposed specification for asphalt saturated burlap

fabric was completed and is now in process of subcommittee ballot. Considerable work was accomplished on the development of a crack-resistance test, with more data being required upon which to base a method. A progress report was presented on a cooperative test series of four emulsions with six laboratories collaborating, for the purpose of rating the emulsions for visual or apparent consistency on a relative basis, using ASTM Method D 1167. The data acquired will be used as a basis for selection and further development of a consistency test procedure. A proposed pressure-stain method was referred to letter ballot of the committee. A method of test which provides a means for evaluating contact compatibility between bituminous materials was published as information only, as part of the Annual Report of the committee. Results of a cooperative test series employing this method were also published at the same time.

D-9 Electrical Insulating Materials

Committee D-9 completed an important revision in the Specifications for Natural Muscovite Mica Based on Visual Quality (D 351). These revisions largely resulted from participation of the committee in the work of the International Committee ISO TC/56 on Mica. In order to clarify the verbal descriptions of visual quality of natural muscovite mica, a set of Master Standards of Waviness, representing the full range of wave variations for visual quality levels of Good Stained and better has been selected. This Master Set of Standards for Waviness will be available for inspection at ASTM Headquarters in Philadelphia. Another important revision was the addition of a new classification V-11 for densely stained mica.

A new Tentative Method of Test for Corrosive Sulfur in Electrical Insulating Oils (D 1275) was issued as tentative. A number of statements on definition and significance for various tests used in the analysis of askarels were completed and added to Methods D 901. Also the Methods of Testing Untreated Paper Used for Electrical Insulation (D 202) were revised to include statements on significance of test for tensile strength, tear strength, ash, and dielectric strength. Important changes were made in the Tentative Methods of Testing Pressure-Sensitive Adhesive Tapes Used for Electrical Insulation (D 1000). These methods are under further study and will be revised again during the coming year.

Committee D-9 has completed two additional projects which will be submitted to the Society through the Administrative Committee on Standards and published early in 1954. The first comprises an extensive revision of the comprehensive Methods of Test for AC Capacitance, Dielectric Constant, and Loss Characteristics of Electrical Insulating Materials (D 150). These revised methods have been under study for several years. Final agreement on the new test procedures has been reached and approved by letter ballot of the committee. The second item covers Specifications for Electrical Insulating Paper of the Interlayer Type used in coils, transformers, and similar electrical apparatus. A Proposed Method of Test for Dielectric Constant Dissipation Factor of Aviation Fuels has also been completed and will be submitted for publication as information.

D-10 Shipping Containers

A notable change in committee activities was accomplished in the joint effort now under way through the combination of subcommittees II, IV, and V, on Methods of Testing, Performance Standards, and Correlation of Tests and Test Results, respectively. This arrangement was found necessary in order to handle efficiently a coordinated program of activities and to prevent duplication of effort. The combined subcommittees were then broken down into four task groups: Drum Test, Vibration Test, Stacking Test, and Drop Test. The Stacking Test Task Group is a new activity to study (1) establishment of a method of testing stacking performance of nonmetallic, noncylindrical containers; (2) stacking of corrugated boxes; (3) extension of stacking study to other types of containers; and (4) conditions of test, that is, floor surface, vibrations present, location of specimen for test, etc. The first operation of this task group is that of conducting preliminary tests in the four participating laboratories.

Two new methods were accepted as tentative: Tentative Method of Test for Water-Vapor Permeability of Packages by Cycle Method, D 1257; Tentative Method of Test for Water-Vapor Permeability of Shipping Containers by Cycle Method, D 1276.

A new method of measuring compression set and drift tendencies of cushioning materials approached completion, pending minor revisions. Also proposed is a load deflection method to determine energy absorption of cushions, and completed is a second revision of the "Bibliography and Abstract of Cushioning Studies."

D-11 Rubber Products

Committee D-11 presented to the Society the first Method for Testing Crude Natural Rubber. This is the result of work of the new D-11 Subcommittee on Crude Rubber organized in 1949. This method gives two practical procedures for determining the amount of harmful dirt in crude natural rubber. The two procedures are the hot oil method and the solvent method. The presence of foreign matter has always been one of the principal sources of difficulty in the control of crude rubber quality. Ordinary inspection methods fail to evaluate this defect adequately. The two procedures recommended have been thoroughly investigated by the subcommittee and found to be satisfactory when used as outlined in the scope. These methods are also being suggested to the ISO/TC 45 on Rubber for consideration. It is felt that the methods will be very helpful in controlling one of the most troublesome factors of crude natural rubber.

New Specifications for Non-Rigid Thermoplastic Compounds for Automotive and Aeronautical Applications (D 1277) were completed by the SAE-ASTM Joint Technical Committee on Automotive Rubber. These specifications enable the engineer to specify non-rigid plastics by means of a coding system comparable to that provided for rubber compounds in the SAE-ASTM Specifications for Rubber and Synthetic Rubber Compounds for Automotive and Aeronautical Applications (D 735).

In recognition of the need for specifications for rubber compounds for general application similar to the SAE-ASTM Standard D 735 a new subcommittee has been appointed by Committee D-11.

D-12 Soaps and Other Detergents

Three new methods of test for metal cleaners and a method for analysis of sodium bicarbonate were accepted by the Society for publication as tentative in 1953. The methods of test for metal cleaners cover buffering action (D 1279), rinsing properties (D 1281), and total immersion corrosion tests (D 1280).

Committee D-12 also prepared the Bibliographical Abstracts of Methods for Analysis of Synthetic Detergents, covering 96 published articles, now available as *STP No. 150*.

D-13 Textile Materials

In recognition of the need for test methods for warp knit fabrics, more generally known as "tricot" fabrics, a new subcommittee was organized by

Committee D-13. This resulted from an industry conference at which representatives of the National Federation of Textiles, Underwear Institute, dyers of warp knit fabrics, fiber producers, and other organizations decided to request Committee D-13 to undertake work in this field. Task groups are already at work on strength and related properties, and on dimensional changes (shrinkage).

A New Method of Test for Relaxation and Felting Shrinkage in Laundering of Stabilized Knit Wool Fabrics (D 1284) was issued as tentative. This is the third in a series of test methods for knit fabrics. The other two methods cover Shrinkage in Laundering of Knit Cotton Fabrics (D 1231) and Knit Rayon Fabrics (D 1232).

Continued activity of the Subcommittee on Cotton Products resulted in completion of the following new test methods for cotton fibers: Maturity (D 1443), Cross-Sectional Characteristics (D 1444), Flat Bundle Method for Strength (D 1445), and Number of Neps (D 1446).

Likewise, the Wool Subcommittee completed several new methods: for Tensile Strength of Wool Fiber Bundles (D 1294), Average Fiber Diameter of Wool Tops by Porous Plug Tester (D 1282), and for Alkali Solubility of Wool (D 1283); also new Methods of Testing and Tolerances for Yarns Containing Wool were completed. The continued extensive use of rayon in tire cord manufacture resulted in the completion of new and revised Methods of Testing and Tolerances (D 885) for this material.

Through the continuing efforts of the Joint ASTM-AATCC Committee on Textile Test Methods, the test methods of the two organizations are being further coordinated. This year the Test for Resistance of Textile Materials to Micro-organisms (D 684) was extensively revised by both organizations. Also two test methods for recovery of textile fabrics from creasing were issued, one using the Vertical Strip Apparatus (D 1295), and the other published as information only covers the Roller Pressure Apparatus.

D-14 Adhesives

In the past year, three new methods, one recommended practice, and four new definitions have been completed. The new methods are susceptibility of adhesives to attack by rats, susceptibility of adhesives to attack by common roaches, and methods of testing electrical properties of adhesives. The recommended practice tests bonded specimens as cantilever beams under repeated constant deflection. The four definitions to be added to Definitions of Terms Relating to Adhesives (D 907) are: diluent, glued laminated wood, built-up laminated wood, and plywood (the latter three terms are defined to agree with those of Committee D-7 on Wood).

One suggested method has been prepared concerning the measurement of tackiness of adhesives by the use of the Tackmeter.

D-15 Engine Antifreezes

Committee D-15 completed a new Method of Test for pH of Concentrated Engine Antifreezes (D 1287). The Method of Test for Ash Content of Concentrated Engine Antifreezes (D 1119) was revised to provide for the use as an alternative of a muffle furnace ignition in place of the Meker Burner. Also the Specifications for Hydrometer-Thermometer Field Tester for Engine Antifreezes (D 1124) were revised.

D-16 Industrial Aromatic Hydrocarbons

Committee D-16 has completed the enlargement of its scope and has organized four subcommittees on (*a*) Monocyclic Aromatics, (*b*) Polycyclic Aromatics, (*c*) Phenolic Compounds, and (*d*) Nitrogen Heterocyclics. The enlarged scope of the committee provides for work on nomenclature, specifications, and methods of test of those aromatic and heterocyclic chemicals, generically classed as coal chemicals, whether derived from coal, petroleum, or any other source, by synthesis or physical separation, and used industrially, either alone or as mixtures, as intermediates, or solvents.

D-18 Soils for Engineering Purposes

Two symposiums were presented at the 1953 Annual Meeting by Committee D-18 as part of the program to present and solicit research information in each of the fields of activity of the committee. The subjects covered by these symposiums are lateral pile load tests and soil dynamics. Each of these symposiums will be available shortly in printed form. Much preliminary work was accomplished in the various subcommittees in the development of ASTM standards for determining the properties and characteristics of soils. Specifications on auger sampling, split spoon sampling, and Shelby tube sampling were reported as approaching completion. The revisions of two test methods of long standing for determining the liquid limit (D 423) and the plastic limit and plasticity index (D 424) were approved, these changes consisting largely of more detailed descriptions of the various steps in the testing technique. A cooperative research program was inaugurated, following the presentation of symposiums, to work out the basic aspects of apparatus and techniques for both direct shear and triaxial compression testing. Good progress was made in the preparation of a test method for determining the California Bearing Ratio of soils. Two test procedures for determining the cement content of soils-cement mixtures were considered, one utilizing the flame photometer and the other, a chemical procedure. A proposed method of test for determining chloride in soils was submitted for subcommittee consideration.

D-19 Industrial Water

Activity by Committee D-19 in the field of industrial waste water has borne fruit in 1953 in the form of five new tentative methods and a tentative general scheme for analysis. The test methods cover chemical oxygen demand (dichromate oxygen demand) (D 1252), chlorine requirements (D 1291), odor (D 1292), pH (D 1293), and sulfides (D 1255). The scheme for analysis and the test for chlorine requirements are applicable to industrial water in general. New tests for residual chlorine (D 1253) and for hardness (additions to D 1126) in industrial water were also accepted in 1953.

Committee D-19 has also undertaken preparation of an index to the Manual on Industrial Water, to be included in a second printing of the Manual early in 1954.

D-20 Plastics

Committee D-20 on Plastics continued its participation in the work of the International Committee ISO/TC 66 on Plastics. The secretariat for this ISO committee is handled by an American group which functions under Committee D-20. This group arranged a meeting of the ISO committee held in Stockholm, Sweden, from August 14 to 18 and also arranged for the United States to be represented by six delegates.

Revised Specificatons for Nylon Injection Molding and Extrusion Compositions (D 789) cover the two compounds currently manufactured. Revised Specifications for Vinyl Chloride-Polymer and Copolymer Rigid Sheets (D 708) were also completed. An important accomplishment was the completion of an extensive set of Specifications and

Methods of Test for Laminated Thermosetting Decorative Sheets (D 1300). Two grades of materials are covered, a standard grade which is highly resistant to heat, and a second grade which is specially constructed to withstand concentrated sources of heat such as lighted cigarettes. The materials covered are suitable for counter and table tops such as used in restaurants, cafeterias, etc., sink tops and kitchen work tops, dinette tables, base boards, wainscoting, and wall panelling. A new Tentative Method of Test for Shrinkage of Molded and Laminated Thermosetting Plastics at Elevated Temperature (D 1299) was also issued.

D-21 Wax Polishes and Related Materials

The initial methods of tests prepared by Committee D-21 on Wax Polishes and Related Materials were accepted at the 1953 Annual Meeting. Three test methods all pertaining to water emulsion waxes provide means for determining nonvolatile matter (D 1239), sediment by means of centrifuge (D 1290), and total ash and silica (D 1288). Other test methods were completed by the committee, both in the field of raw materials and products. Suggested methods will be published as information only for determining the concentration of additives in Carnauba or other vegetable waxes, and the use of refractive index of 100 C as an indication of wax adulteration, respectively. Two proposed methods for measuring slip resistance were completed, the present plan being to publish these methods as information only. These two methods involve the use of the Sigler and James types of apparatus, respectively. Much was accomplished in arriving at a test method for measuring water spot resistance of floor waxes. General agreement was reached on the properties which should be included in a specification for industrial-type water emulsion waxes.

D-23 Cellulose and Cellulose Derivatives

In its first full year of operation, the committee has completed two new test methods and has revised a method formerly under the jurisdiction of Committee D-1 on Paint Varnish, Lacquer and Related Products. The two new methods are: the method of testing moisture content of cellulose products, and testing viscosity of cellulose derivatives by the ball-drop method. The new revision proposed is of the Methods of Testing Cellulose Acetate (D 871).

E-1 Methods of Testing

Committee E-1 completed new Methods of Test for Measuring Water Vapor Transmission of Materials in Sheet Form (E 96). This is the result of approximately four years of cooperative work in correlating the various ASTM methods of water vapor transmission. The new methods are applicable to a variety of materials such as paper, plastic films, and sheet materials in general. They give five procedures for water vapor permeability under different test conditions. It is hoped that the new methods will be found generally acceptable and will eventually supersede the presently used methods.

A number of important changes were made in the Standard Specifications for ASTM Thermometers (E 1). These included three new ASTM kinematic viscosity thermometers for use in viscosity tests at low temperatures. They cover ranges of −2.5 to +2.5 F, −42.5 to −37.5 F, and −67.5 to −62.5 F for tests at 0 F, −40 F, and −65 F, respectively. Also specifications for two ASTM antifreeze freezing point thermometers were issued covering temperature ranges of −35 to +35 F, and −65 to +5 F. The 18 specifications for ASTM precision thermometers were adopted as standard.

E-2 Emission Spectroscopy

A major accomplishment of Committee E-2 in 1953 was the completion of the first extensive compilation of methods for emission spectrochemical analysis, covering more than fifty suggested methods and practices and the four current ASTM tentatives in this field. One of these tentatives (E 101 – 53 T) is the first ASTM method for spectrochemical analysis of aluminum and its alloys. Also completed in 1953 was Part III of the Index to Literature on Spectrochemical Analysis, covering the years 1946 through 1950.

Committee E-2 is actively at work on studies of a number of the suggested methods with the aim of advancing them to tentative status in 1954.

E-4 Metallography

A series of meetings with representatives of ASTM Committee B-5 on Copper and Copper Alloys has helped toward eliminating discrepancies between Method E 79 on Grain Size of Wrought Copper and Copper Alloys and Method E 91 on Grain Size of Non-Ferrous Metals (Other Than Copper). The committee hopes that eventually one grain size method for all metals and alloys (both ferrous and non-ferrous) can be attained.

Subcommittee XI on Electron Microstructure of Steel of Committee E-4 has published its third progress report dealing with a re-examination of the techniques involved in its work. The techniques which have been proved by these investigations formed the basis for a symposium on these methods held at the 1953 ASTM Annual Meeting.

Committee E-4 has laid plans for a very extensive metallographic exhibit at the 1954 Annual Meeting. In addition to the general industrial section, there will be a student section and a foreign section. The foreign section will include, among others, special exhibits by Antonio Scortecci of Istituto Siderurgico, Genoa, Italy, and by B. W. Mott, Atomic Energy Research Establishment, Harwell, England. The response to student and foreign participation has been excellent.

E-5 Fire Tests of Materials and Construction

Work was resumed at the Forest Products Laboratory on a research program sponsored by Committee E-5 for developing smaller-size tunnel test equipment similar to that specified in ASTM Tentative Method E 84. Additional funds were solicited from industry to underwrite the completion of this program. The preparation of a proposed tentative method of test necessary in defining "noncombustibility" as applied to building materials, was advanced considerably during the past year. Drafts of a proposed method for establishing the fire hazard of roof coverings were prepared, and further discussion with representatives of the roofing industry is now going on. Certain revisions to the Standard Methods of Fire Tests of Building Construction and Materials (E 119) were approved by the Society, applying to description of the test structures, the hose stream test, and the time of testing.

E-7 Non-Destructive Testing

Tentative Reference Radiographs for the Inspection of Aluminum and Magnesium Castings (E 98) have been published, consisting of over 100 negatives showing the various types of discontinuities encountered. These radiographs have been reproduced from Navy Department, Bureau of Aeronautics Reference Radiographs, dated August 1, 1951.

Additional work is nearing completion on Reference Radiographs for Steel Welds, which is expected to be published in 1954.

A technical session on non-destructive testing techniques was held during the

Annual Meeting, and the papers presented will be printed in forthcoming issues of the ASTM BULLETIN.

E-9 Fatigue

Three years ago the committee initiated on a trial basis the publication of references to articles on fatigue published during the previous year. The sale of this first list of references which appeared in 1951 (1950 articles) indicated a fair demand and the committee published in 1952 and again this year (*STP No. 90*) those articles which appeared in the preceding year. These references are printed on one side of the page only and are displayed in such a fashion that they can be readily cut apart and mounted on 3- by 5-in. cards in case a reader wishes to have his own card file of these articles.

Following its recent past practice the committee sponsored two sessions of papers on fatigue at the 1953 Annual Meeting.

E-10 Radioactive Isotopes

A most interesting and very well-attended Symposium on Radioactivity in ASTM work was sponsored by Committee E-10 at the 1953 Annual Meeting. In addition to a demonstration period, an exhibit of instruments and equipment, and a panel discussion, the following subjects were covered by well-known authorities: (1) properties and uses of radioisotopes, (2) applications of radioactive measurements to ASTM work, (3) design of radioisotope laboratories, (4) training personnel in radioisotope techniques, (5) instrumentation, and (6) management problems resulting from radioisotope utilization by industry.

The purpose of this symposium was to acquaint other ASTM committees, through members attending the symposium, of the possibilities of utilization of radioisotopes in their standardization work on testing methods.

E-11 Quality Control

Committee E-11 has had several task groups actively at work on the following projects: (1) study of ASTM sampling plans, (2) planning interlaboratory test programs, (3) number of tests for a desired precision of an average, (4) bulk sampling, (5) smoothing empirical data, (6) precision and accuracy, and (7) design of experiments. The committee completed arrangements to sponsor a Symposium on Design of Experiments to be held during ASTM Committee Week in Washington on February 2, 1954. For further details regarding the activities of this committee, please turn to page 27.

E-12 Appearance

Committee E-12 issued this year its first method which provides a Test for 45-Deg 0-Deg Directional Reflectance of Opaque Specimens. This method was developed in cooperation with Committees C-22 on Porcelain Enamel, D-1 on Paint, Varnish, Lacquer, and Related Products, and D-6 on Paper and Paper Products. It represents a proposed consolidation of a proposed method prepared by Committee C-22 and of the present Standard Method of Test for Daylight 45-deg, 0-deg Luminous Directional Reflectance of Paint Finishes (D 771), and the Standard Method of Test for 45-deg, 0-deg Directional Reflectance for Blue Light (Brightness) of Paper (D 985).

E-13 Absorption Spectroscopy

In 1953 Committee E-13 assumed the responsibility for continued maintenance and development of the Wyandotte-ASTM punched-card infrared index. The index consists of IBM cards punched according to a definite coding system originated at Wyandotte Chemicals Corp. by L. E. Kuentzel and modified in 1953 by action of the Subcommittee on Standard Data of Committee E-13 after a study of the various existing codes for indexing infrared spectra. Under the auspices of Committee E-13, the currently available infrared spectra have been coded according to the revised coding system, and decks of approximately 10,000 index cards will be distributed by ASTM early in 1954. Newly available spectra will be coded and additional index cards will be issued at regular intervals.

Effect of Temperature on the Properties of Metals

THE ASTM-ASME Joint Committee co-sponsored with the Research Committee on High Temperature Steam Generation, Power Division of the ASME, a series of four papers presented during the 1952 Annual Meeting of the ASME. At the 1953 ASTM Annual Meeting in Atlantic City the Joint Committee sponsored a five-session "Symposium on Effect of Temperature on the Brittle Behavior of Metals with Particular Reference to Low Temperature." This Symposium, which included more than 25 papers is currently being edited for publication as an ASTM special technical publication and will appear about April, 1954.

The Low-Temperature Panel of the Joint Committee has continued active in its survey of the elevated temperature properties of various families of materials. The third of this series of surveys was published as *ASTM STP No. 151* in October, 1953, under the title "Report on the Elevated Temperature Properties of Chromium-Molybdenum Steels." (For a report of the last meeting of this committee, please turn to p. 28.)

American Concrete Institute to Celebrate Golden Anniversary

THE American Concrete Institute will celebrate its Golden Anniversary at its fiftieth annual convention in Denver, Colo., Feb. 22–25, 1954. Commemorating 50 years of service to the concrete engineering field, the ACI convention will feature sessions devoted to the latest developments in structural design, precast and prestressed concrete, and research on materials and properties of concrete.

A special session will feature addresses by noted industry leaders—W. A. Dexheimer, Commissioner of Reclamation, Bureau of Reclamation; Rear Admiral Joseph F. Jelley, Director of Construction, Department of Defense; Norman P. Mason, Chairman, Construction and Civic Development Department Committee, U. S. Chamber of Commerce; and Major General Samuel D. Sturgis, Jr., Chief of Engineers, U. S. Army—on the use of concrete by the construction industry and government agencies.

General Chairman of the local committee is Robert F. Blanks, Vice-President, Great Western Aggregates, Inc., Denver, who is an active member of ASTM Committees C-1 on Cement and C-9 on Concrete.

Manual of Photogrammetry

(2nd Ed.), 876 pages, 300 ill., $12.50.

THE Manual of Photogrammetry, now issued in revised and enlarged form, is of distinct interest to all civil and soils engineers. The increased use of aerial photography for the location of highways, water aqueducts, and transmission lines, and for the identification and extent of soil configurations—miles from the point of ground observations, has brought photogrammetry from an expensive curiosity to a vital engineering tool.

The new manual, a collaboration of outstanding men in their field, discusses each phase of photogrammetry from the equipment used to the final survey compilations and their application to agriculture, engineering, geology, etc.

The Manual may be obtained by writing to the American Society of Photogrammetry, 1000—11th St., S.W., Washington 1, D. C.

Administrative Committee on Standards—December Actions

Recommendations Approved from Steel, Concrete, Ceramic Whitewares, Plastics, and Filler Metal Committees

A LARGE number of actions were taken by the Administrative Committee on Standards, December 16, on proposals for new tentatives and revisions of existing ASTM Tentatives. These were submitted by Committees A-1 on Steel, C-9 on Concrete and Concrete Aggregates, C-21 on Ceramic Whitewares, D-20 on Plastics, and the Joint AWS-ASTM Committee on Filler Metal.

Steel

Two new specifications have been written by Committee A-1:

Ferritic Alloy Steel Forged and Bored Pipe for High-Temperature Service (A 369) covers, as the title indicates, heavy wall pipe suitable for bending and other forming operations and for fusion welding.

Carbon and Alloy Steel Forgings for Pressure Vessel Shells (A 372) was prepared by a special group of producers and consumers in response to a demand for an ASTM specification covering these materials. The specification applies to relatively thin-walled forgings made from three classes of carbon steel and two classes of alloy steel, and also includes the integral forging of ends of seamless pipe or tubing. These materials are not intended for use if they will be in any way subjected to welding.

The Steel Committee also received approval of revisions of a number of the tentative specifications under its jurisdiction.

In order to bring the requirements for cut lengths of steel tubes up to date with current manufacturing practice a footnote applying to length tolerances was added to the tolerance tables of each of five specifications to apply to cut lengths up to and including 24 ft, and for lengths over 24 ft, permitting an additional over tolerance of $\frac{1}{8}$ in. for each 10 ft or fraction. This change occurs in the following specifications:

Seamless Cold-Drawn Low-Carbon Steel Heat Exchanger and Condenser Tubes (A 179)

Seamless Cold-Drawn Intermediate Alloy-Steel Heat Exchanger and Condenser Tubes (A 199)

Seamless Alloy-Steel Boiler, Superheater, and Heat-Exchanger Tubes (A 213)

Actions Taken by Administrative Committee on Standards, December 16, 1953

New Tentatives

Specifications for:

- Ferritic Alloy-Steel Forged and Bored Pipe for High-Temperature Service (A 369 – 53 T)
- Carbon and Alloy-Steel Forgings for Pressure Vessel Shells (A 372 – 53 T)
- Corrosion-Resisting Chromium and Chromium-Nickel Steel Welding Rods and Bare Electrodes (A 371 – 53 T)
- Lightweight Aggregates for Structural Concrete (C 330 – 53 T)
- Lightweight Aggregates for Concrete Masonry Units (C 331 – 53 T)

Methods of:

- Sampling Whiteware Clays (C 322 – 53 T)
- Test for Free Moisture Content of Clays (C 324 – 53 T)
- Test for Wet Sieve Analysis of Whiteware Clays (C 325 – 53 T)
- Test for Drying and Firing Shrinkages of Whiteware Clays (C 326 – 53 T)
- Test for Linear Thermal Expansion by the Interferometric Method (C 327 – 53 T)
- Test for Modulus of Rupture of Fixed Dry-Pressed Whiteware Specimens at Normal Temperature (C 328 – 53 T)
- Test for True Specific Gravity of Fired Whiteware Materials (C 329 – 53 T)
- Test for Chlorine Content of Vinyl Chloride Polymers and Co-polymers (D 1303 – 53 T)

Revisions of Tentatives

Specifications for:

- General Requirements for Structural Steel (A 6 – 53a T)
- Seamless Cold-Drawn Low-Carbon Steel Heat-Exchanger and Condenser Tubes (A 179 – 53 T)
- Alloy-Steel Bolting Materials for High-Temperature Service (A 193 – 53 T)
- Seamless Cold-Drawn Intermediate Alloy-Steel Heat Exchanger and Condenser Tubes (A 199 – 53 T)
- Seamless Intermediate Alloy-Steel Still Tubes for Refinery Service (A 200 – 53 T)
- Seamless Alloy-Steel Boiler, Superheater, and Heat-Exchanger Tubes (A 213 – 53 T)
- Electric-Resistance-Welded Heat-Exchanger and Condenser Tubes (A 214 – 53 T)
- Carbon Steel Forgings for Locomotives and Cars (A 236 – 53 T)
- Low-Alloy Structural Steel (A 242 – 52 T)
- Welded Austenitic Stainless Steel Boiler, Superheater, Heat Exchanger and Condenser Tubes (A 249 – 53 T)
- Quenched and Tempered Steel Bolts and Studs with Suitable Nuts and Plain Washers (A 325 – 53 T)
- Seamless Ferritic Alloy-Steel Pipe for High Temperature Service (A 335 – 53a T)
- Low-Carbon High-Nickel Steel Plate for Pressure Vessels (A 353 – 53 T)
- Quenched and Tempered Alloy-Steel Bolts and Studs with Suitable Nuts (A 354 – 53 T)
- Copper and Copper-Alloy Metal Arc-Welding Electrodes (B 225 – 53 T)

Definition of:

- Terms Relating to Plastics (D 883 – 53 T)

Withdrawal of Tentatives

Methods of:

- Mechanical Testing of Structural Steel (A 359 – 52 T)

Methods and Definitions for:

- Mechanical Testing of Steel Bars (A 330 – 51 T)

Withdrawal of Emergency Alternate Provisions

Specifications for:

- Heat-Treated Alloy-Steel Bars (EA – A 286)
- Alloy-Steel Bars to End-Quench Hardenability Requirements (EA – A 304)
- Hot-Rolled Alloy-Steel Bars (EA – A 322)
- Cold-Finished Alloy-Steel Bars (EA – A 331)

Electric-Resistance-Welded Steel Heat-Exchanger and Condenser Tubes (A 214)

Welded Austenitic Stainless Steel Boiler, Superheater, Heat Exchanger, and Condenser Tubes (A 249)

Tentative Specifications for Alloy-Steel Bolting Material for High-Temperature Service (A 193) are revised in Section 10(*a*) to clarify the present requirements for testing material heat treated in continuous furnaces as follows: "When heat treated without interruption in furnaces, the material in a lot shall be the same heat, same prior condition, same size, and subjected to the same heat treatment. Not fewer than two tension tests shall represent a lot selected on the basis of one tension test from each 10,000 lbs."

Because grade T3 (1.75 Cr, 0.75 Mo) is no longer being produced the reference to it is deleted from the following alloy-steel specifications:

Seamless Cold-Drawn Intermediate Alloy Steel Heat-Exchanger and Condenser Tubes (A 199)

Seamless Intermediate Alloy-Steel Tubes for Refinery Service (A 200)

Seamless Alloy-Steel Boiler, Superheater, and Heat-Exchanger Tubes (A 213)

Specifications A 200 and A 213 are also revised with respect to the permissible silicon content of grade T9 from "0.50 to 1.00" to "0.25 to 1.00" so that the material will not crack during rotary piercing. Low silicon in combination with high chromium is necessary to overcome this tendency.

The same change is made in silicon content of grade P9 in Tentative Specifications for Seamless Ferritic Alloy Steel Pipe for High Temperature Service (A 335).

In order to facilitate meeting tension requirements, in Tentative Specifications for Carbon Steel Forgings for Locomotives and Cars (A 236), the permissible carbon content of class F is raised from "0.40 to 0.45" to "0.55 to 0.59" per cent. This change brings the specification in line with the AAR Specification.

Tentative Specifications for Quenched and Tempered Steel Bolts and Studs with Suitable Nuts and Plain Washers (A 325) were redrafted as a result of a serious study of several years' duration by users of the material produced under this specification. These revisions were worked out in order to make the requirements suitable for structural steel application.

In Tentative Specifications for Low Carbon High Nickel Steel Plate for Pressure Vessels (A 353) provision is made for the use of $\frac{1}{2}$-in. diameter round tension specimen for material over $\frac{3}{4}$ in. diameter.

Tentative Specifications for Quenched and Tempered Alloy Steel Bolts and Studs with Suitable Nuts (A 354) are revised to recognize the use of this material for limited applications at elevated temperatures and to establish a head marking for grade BD bolts.

Tentative Specification for Low-Alloy Structural Steel (A 242) is revised to bring it in line with current commercial practice and terminology.

Committee A-1 also recommended the withdrawal of Tentative Methods for Mechanical Testing of Structural Steel (A 359) and of Tentative Methods and Definitions for the Mechanical Testing of Steel Bars (A 330) which have been rendered obsolete by the publication of Tentative Methods and Definitions for Mechanical Testing of Steel Products (A 370). This change also makes it necessary to delete from Tentative Specifications for General Requirements for Structural Steel (A 6) the reference to A 359 and the substitution of a reference to A 370.

Emergency Alternate Provisions were withdrawn in Specifications for Heat-Treated Alloy-Steel Bars (EA – A 286); Alloy Steel Bars to End-Quench Hardenability Requirements (EA – A 304); Hot-Rolled Alloy-Steel Bars (EA – A 322); Cold-Finished Alloy-Steel Bars (EA – A 331).

Filler Metal

The American Welding Society-ASTM Joint Committee on Filler Metal has prepared Tentative Specifications for Corrosion-Resisting Chromium and Chromium-Nickel Steel Welding Rods and Bare Electrodes (A 371), the scope of which reads as follows: "These specifications are for bare corrosion-resisting chromium and chromium-nickel steel welding rods for use with the atomic hydrogen and inert-gas metal-arc (nonconsumable electrode) welding processes and electrodes for use with the submerged arc and inert-gas metal-arc (consumable electrode) welding processes. These welding rods and electrodes, commonly referred to as filler metals, include those alloy steels designated as corrosion or heat-resisting chromium and chromium-nickel steels, in which chromium exceeds 4 per cent and nickel does not exceed 50 per cent."

The Joint Committee also recommended the addition to Tentative Specifications for Copper and Copper-Alloy Metal Arc-Welding Electrodes (B 225) of filler metal for inert-gas metal-arc welding which was not included in the earlier edition of the specifications.

Concrete and Concrete Aggregates

Committee C-9 has found the existing Standard Specifications for Lightweight Aggregates for Concrete (C 130) to be out-of-date and has completed 2 of 3 proposed new tentative specifications to replace it. In these new specifications more specific treatment is given to the various types of lightweight aggregates and to specific types of concrete:

Tentative Specifications for Lightweight Aggregates for Concrete Masonry Units (C 331) cover lightweight aggregates intended for use in concrete masonry units in which a prime consideration is lightness in weight. Specifications for Lightweight Aggregates for Structural Concrete (C 330) cover lightweight aggregates intended for use in structural concrete in which prime considerations are lightness in weight and compressive strength of the concrete.

Ceramic Whiteware

In response to long-felt needs in the industry, Committee C-21 has developed seven new methods:

Method for Sampling of Whiteware Clays (C 322).

Method of Test for Wet Sieve Analysis of Whiteware Clays (C 325). This procedure will serve for the checking of clay shipments as well as for plant control.

Method of Test for Free Moisture Content of Whiteware Clays (C 324).

Methods for the Determination of Drying and Firing Shrinkages of Whiteware Clays (C 326).

Method of Test for the Determination of Modulus of Rupture of Fired Dry-Pressed Whiteware Specimens at Normal Temperature (C 328). Applicable to both glazed and unglazed test specifications.

Method of Test for Determination of Linear Thermal Expansion by the Inferometric Method (C 327). Applicable at temperatures below 1000 C.

Method of Test for True Specific Gravity of Fired Whiteware Materials (C 329). This method is not applicable to materials perceptibly attacked by water.

Plastics

Committee D-20 has written a Tentative Method of Test for Determining Chlorine Content of Vinyl Chloride Polymers and Co-polymers (D 1303) in which is outlined the procedure used throughout the industry as a means of characterizing chemically these resins.

The Plastics Committee also has revised several of the Tentative Definitions of Terms Relating to Plastics (D 883) as a result of specific requests to bring them into accord with current usage in the field of plastics technology.

Extensive Symposium Program Developing for Chicago Annual Meeting

Preliminary Outline of Some Technical Sessions Now Available

ANOTHER big and varied technical program is shaping up for the 1954 Annual Meeting of the Society which will be held at the Sherman and Morrison Hotels in Chicago, June 14–18.

In most cases final arrangements have not been completed by the several committees sponsoring the symposiums but as this issue goes to press, the following information on symposiums is available:

Effect of Cyclic Heating and Stressing of Metals at Elevated Temperatures

Sponsoring Committee: Joint Committee on Effect of Temperature

What We Need to Know About Creep by John S. Dorn, University of California

The Creep-Rupture Properties of Aircraft Sheet Subjected to Intermittent Load and Temperature by Glen J. Guarnieri, Cornell Aeronautical Laboratory, Inc.

The Effect of Heat and Stress at High Temperature on Chromium-Nickel-Iron Alloys by G. F. Geiger, International Nickel Co.

The Effect of Cyclic Temperature on the Scaling Behavior of Heat-Resisting Alloys, by H. E. Eiselstein, International Nickel Co.

The Effect of Temperature Cycling on the Rupture Strength of Some High Temperature Alloys by J. Miller, General Electric Co.

Effect of Cyclic Temperature and Stress on the Stress-Rupture Strength of Type 347 Stainless Steel by E. E. Baldwin, General Electric Co.

The Problem of Thermal Stress Fatigue in Austenitic Stainless Steels at Elevated Temperatures by L. F. Coffin, Jr., General Electric Co.

Experiments on the Effects of Temperature and Load Changes on Creep-Rupture of Steels by G. V. Smith, U. S. Steel Corp.

Cyclic Creep and Stress-Rupture Behavior of Inconel at 1700 and 1800 F by W. B. Hoyt, M. W. Kellogg Co.

Constant and Cyclic Stress Creep Tests of Several Sheet Materials by Ward F. Simmons and H. C. Cross, Battelle Memorial Institute

Improved Construction and Performance Through Building Research and Testing

Sponsoring Committee: E-6 on Methods of Testing Building Constructions

Definite titles are not yet available.

R. H. Gloss, Timber Engineering Co.

Kaufmann and Fabry

Chicago's Lakefront Skyline

A summary of tests on full scale timber, arches, trusses, and isolated joints under simulated loadings.

A. J. Steiner, Underwriters' Laboratories. Fire tests of building structures and building materials and their utilization in building code requirements.

J. R. Stillinger, Oregon Forest Products Laboratory. A summary of correlative work between laboratory and full-scale tests of timber construction.

Engineer Research & Development Laboratories, Corps of Engineers, U. S. Army. Structural and environmental evaluation of pre-fabricated buildings.

C. B. Monk, Jr., Armour Research Foundation. Comparison of results from laboratory tests and tests of large model masonry structures.

R. F. Luxford, U. S. Forest Products Laboratory. Glued and nailed roof trusses for light frame construction.

L. W. Wood, U. S. Forest Products Laboratory. Structural performance requirements in housing codes.

Odor

Sponsoring Committee: D-22 on Methods of Atmospheric Sampling and Analysis

Accurate Measurement of the Intensity of Odors by Louis C. Barail, Consulting Biochemist and Toxicologist

Odor Pollution from an Official's Viewpoint by Charles W. Gruber, Cincinnati Bureau of Smoke Inspection

Measuring Concentrations of Hydrocarbon and Organic Vapors in Air by Catalytic Combustion by R. J. Ruffe, Catalytic Combustion Corp.

Odor: A Proposal for Some Basic Defi-

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nitions by Edward Sagarin, Standard Aromatics, Inc.

Studies of Submarine Atmospheres by Julius Sendroy, Naval Medical Research Institute

A Method for Measuring the Emission of Organic Odors from Industrial Stacks, Automotive Exhausts, and Other High Concentration Sources by W. R. Calvert, Oxy-Catalyst

Organoleptic Appraisal of Three Component Mixtures by A. H. Gee, Foster D. Snell, Inc.

Further Studies in Sampling of Odors by Activated Carbon Devices by A. Turk, Connor Engineering Corp.

Permeability of Soils

Sponsoring Committee: **D-18 on Soils for Engineering Purposes**

Controlled Test Methods in Permeability Testing and Interpretation of Test Data by Donald M. Burmister, Columbia Univ.

The Effect of Gravel Content on the Permeability of Laboratory Sand-Gravel Specimens by C. W. Jones, Bur. Reclamation.

Water Movement Through Porous Hydrophilic Systems Under Capillary, Electric, and Thermal Potentials by Hans F. Winterkorn, Princeton University

Measurement of the Hydraulic Conductivity of Soil in Place by Don Kirkham, Iowa State College

Permeability Measurements on Compacted Soil by T. W. Lambe, Massachusetts Institute of Technology

Low-Head Permeameter for Granular Materials by E. G. Yemington, Bureau of Public Roads.

W. O. Smith, Geological Survey, to discuss a sampler and test methods for ground water samples, including the use of de-aired water and natural ground water to limit the effects of base exchange

Temperature Classification of Insulating Material

Sponsoring Committee: **D-9 on Electrical Insulating Materials**

Improved Specimen Holder for Use at Temperatures Up to 500 C by A. H. Scott, P. Ehrlich, J. F. Richardson, National Bureau of Standards

Dielectric Measurements at High Temperatures by Carl Brodhun, E. I. du Pont de Nemours & Co., Inc.

Some Properties of Thermosetting Material at Elevated Temperatures by R. R. Winans, New York Naval Shipyard

Dielectric Properties of Certain Plastics at Temperatures up to 200, and Some Problems Encountered in Measuring Them by Thomas Hazen, Bakelite Corp.

Stability of Plastics by R. R. Winans, New York Naval Shipyard

Thermal Stability of Polyvinyl Chloride Insulating Compounds by R. C. Bartlett, Natvar Corp.

Aging of Silicone Treated Glass Cloth by O. E. Anderson, Westinghouse Electric Corp.

Thermal Stability of Varnished Cloth and Tapes Used for Electrical Insulation by R. C. Bartlett, Natvar Corp.

Heat Aging of Insulating Varnish by H. I. Morgan and K. N. Mathes, General Electric Co.

High Temperature Characteristics and Stability of Insulating Varnish by A. H. Haroldson, Continental-Diamond Fibre

Heat Stability of Silicones by J. S. Hurley, General Electric Co.

Heat Stability of Mica Products by K. Coutlee, Bell Telephone Labs.

High Temperature Properties of Mica by J. Ruscito, Scintilla Magneto

Test Method Modifications for High Temperature Fluorocarbon Plastics by M. A. Rudner, U. S. Gasket Co.

Heat Aging of Sheet and Tape Insulation by K. N. Mathes and H. I. Morgan, General Electric Co.

Coal Sampling

Sponsoring Committee: **D-5 on Coal and Coke**

The Development of the Theoretical Basis of Coal Sampling by W. M. Bertholf, Colorado Fuel & Iron Corp.

A Test Accuracy of a Revolving Spoon Sampler by A. O. Blatter, Union Electric Co. of Missouri

Sampling Mixed Coals by Small Increments by R. L. Coryell and F. J. Schwerd, Consolidated Edison Co. of N. Y.

Tests of Accuracy of a Mechanical Coal Sampler by R. L. Coryell and F. J. Schwerd, Consolidated Edison Co.

Multi-Lot Sampling, the Accuracies in Sampling of Large Coal Shipments by T. A. Miskimen and R. S. Thurston, American Gas & Electric Service Corp.

Tests of the Geary-Jennings Sampler at Cabin Creek by W. M. Bertholf, Colorado Fuel & Iron Corp., and W. L. Webb, American Gas & Electric Corp.

Recent British Work on Coal Sampling by R. W. Tomlinson, National Coal Board

The Variance of Reduction and Analysis by W. W. Anderson, Commercial Testing and Engineering Co.

Papers Committee Meets in February

THE Administrative Committee on Papers and Publications will meet February 11 at which time consideration will be given to the development of the program for the Annual Meeting in June. Quite a number of formal symposiums are in prospect as indicated above, and in addition the Papers Committee has a number of offers that have been submitted individually. While all offers were to be in the hands of the Papers Committee by January 15, any significant contribution which has not been brought to the attention of the Papers Committee should be submitted immediately. It could be that consideration still can be given to such offers.

Society Expanding Headquarters Facilities

IN AN effort to meet the increased needs of an expanding organization, the Society purchased in November a property immediately to the rear of the present Headquarters building in Philadelphia. The property includes a sizable building used for office space and garage; a two-family dwelling, and other buildings attached to the larger structure.

While considerable repair work will need to be done on the newly purchased buildings, it is felt that it can be made into comfortable offices and adequate shipping and storage space. Studies and estimates are now under way with the hope that in the next few months some of our Staff can be more comfortably located in the renovated building.

Tied in with the purchase of the new property was the sale of about three quarters of a lot adjacent to the new property, which was purchased by the Society a few years ago. This parcel of ground was sold to the Society's neighbors, the Academy of Natural Science, who will utilize it in their future expansion plans. The agreement with the Academy provides that the two scientific and educational groups will cooperate in various matters affecting the use of the property, including the joint use of Quarry Street which divides the ASTM properties.

In 1952 a Building Headquarters Expansion Committee was appointed by the Directors, under the chairmanship of Past-President H. L. Maxwell. This group developed considerable data on Staff and building needs and held discussions with other interested parties in the Headquarters neighborhood. After considering the expansion of the Society in recent years and the many conditions which might influence its growth, it was concluded that in the next ten to twenty year period the needs might double with respect to Staff and space.

When the Society moved to 1916 Race St. in 1946 there were about 40 on the Staff and the number is now about 60, so that the working space has become definitely crowded.

The additional building cost about $87,000 and will be financed out of the Society's available funds. Further details of this expansion will undoubtedly be included in the Annual Report of the Board of Directors to be presented at the 1954 Annual Meeting in Chicago.

ASTM Bulletin

JANUARY, 1954

NO. 195

NINETEEN-SIXTEEN
RACE STREET
PHILADELPHIA 3, PENNA.

Greetings—to the Members of ASTM and Those Who May Read This

Your Board of Directors, Officers, and Headquarters' Staff extend to you best wishes for a New Year full of health and happiness.

Under health, we include both physical and economic health. Prophets of gloom to the contrary, considered business opinion feels 1954 will be a good year. Presently, industrial activity is high, salaries are generous, and the savings' banks are full of money. The cold war is getting colder, and some decrease in defense spending will probably occur. The consensus of businessmen is that this will result in an over-all reduction of about 10 per cent in our gross production.

This modest reduction would appear not to be a matter of too serious concern. Some mills, for example, have been operating at top speed for maximum production, which in some cases necessitated the use of inefficient equipment and procedures to get the necessary merchandise. Some letup in the mad rush for production will give time for more thoughtful consideration and research on how to do things better, and how to make new things.

We have also wished you happiness, and such can take many forms. Perhaps the best happiness lies in the recognition of a problem solved and a job well done. ASTM is a standardizing agency, but this does not mean our thinking should be standardized.

The following comment of Alfred North Whitehead is pertinent:

"In a living civilization there is always an element of unrest, for sensitiveness to ideas means curiosity, adventure, change. Civilized order survives on its merits and is transformed by its power of recognizing its imperfections."

We in ASTM have a big job ahead of us. New materials are appearing at a rapid pace and new fields of investigation concerning methods of test and specifications for these new materials are opening up. We also have a job to do to extend the use of existing ASTM standards where they are not now used.

In closing, we would all like to thank you for your productive labors over the year just passed and for the generous dedication of your time to the Society. We know we can count on you to repeat this performance in 1954.

L B Beard Jr.

January 1, 1954 President

This greeting was sent directly to all members early in January.

Directors Appoint Investment Advisory Committee

With the growth in the funds the Society invests, both in its general and award funds, and in its duties as custodian of committee funds, the Finance Committee of the Society has had to devote a considerable amount of time at its meetings in reviewing the portfolio, and establishing logical investment policies in the best interests of the Society. As a result of discussion during the past year, the Society's Directors recently authorized the appointment of an Investment Advisory committee which will be charged with the responsibility of recommending an investment formula or formulas and to carry on a continuing review of the portfolio.

An Investment Committee of more or less permanent duration can provide a background of information that will be helpful to the Finance Committee and the Treasurer and it is planned that the current group will operate on a continuing basis. Several of the men are members and very conversant with the work of the Society, but each has personally been interested in financial and investment problems, and, coming from diverse industries the group as a whole is in a position to give to the Finance Committee helpful advice and recommendations which should be of material help. The Investment Advisory Committee will in no way abrogate the functions of the Finance Committee. Final actions on securities will continue to be the responsibility of the Finance Committee which consists of the three immediate Past-Presidents of the Society, two Directors appointed at large and the President *ex-officio*.

The personnel of the new Investment Advisory Committee includes the following:

E. J. Albert, President, Thwing-Albert Instrument Co., Philadelphia, Pa.
Henry Grinsfelder, Head, Coatings, Adhesives and Plasticizers, Applications Research Laboratory, Rohm & Haas Co., Philadelphia, Pa.
H. M. Hancock, Manager, Product Control Department, The Atlantic Refining Co., Philadelphia, Pa.
W. J. Jenkins, President, John Lucas and Co., Inc., Philadelphia, Pa.
N. L. Mochel, Manager, Metallurgical Engineering, Westinghouse Electric Corp., Philadelphia, Pa.
W. Cooper Willits, Manager, Statistical Dept., Kidder, Peabody and Co., Philadelphia, Pa.
R. J. Painter, ASTM Executive Secretary and Treasurer

It will be noted that the committee members are located in the Philadelphia area, an arrangement which makes for ease of meeting and contact.

International Conference on Soil Mechanics

The Third International Conference on Soil Mechanics and Foundation Engineering, held in Switzerland August 14 to 27, was attended by more than 800 people from all over the world.

W. G. Holtz, U. S. Bureau of Reclamation, Denver, and Secretary of ASTM Committee D-18 on Soils for Engineering Purposes, and G. P. Tschebotarioff, Princeton University, represented the Society.

A. E. Cummings, Research Director, Raymond Concrete Pile Co., and also a member of Committee D-18, attended the Conference and represented the United States at the meetings of the international executive committee of which he is vice-president for North America.

Membership Over 7500; Members' Continued Aid Enlisted

WITH a net gain in 1953 of 239 new members, the Society's membership, as of December 31, 1953, totaled 7581, classified as follows:

Honorary	21
Perpetuity and Life	11
Sustaining	276
Company (including Trade Associations)	1805
Individual (including Institutions, Scientific Associations, and Government Departments)	5364
Junior (under 27 years)	104

In addition, approximately 500 students in engineering schools throughout the country were enrolled as ASTM student members.

Although the new members enrolled totaled 658 (14 more than in 1952), the losses were somewhat heavier, bringing the net gain to the above figure. Actually the names of 104 new companies (11 more than in 1952) and 554 individuals (3 more than in 1952) were added to our rolls the past year, but deaths, resignations, and other losses took the usual toll.

Much of the credit for the steady and continuing growth of the Society should go to our current members who in large measure are responsible for maintaining the organization on an even keel through their interest, support, and recommendation of membership prospects.

In the maintenance of the Society's expanding technical activities the income from membership dues necessarily plays an important part, and of especial significance in this respect is the support of our sustaining members. This class, established in 1930, now embraces 276 company members who by transfer of their corporate affiliation to the sustaining type have taken advantage of the incentives offered sustaining members including very liberal publication privileges, and at the same time, through the annual dues of $150, aid substantially in underwriting the work of the Society, so significant in the various fields of industry.

The Directors serving on the Membership Committee, and in fact all officers of the Society, are sincerely appreciative of the interest and activity of all ASTM members, and anticipate the continuing support of our members in 1954—hopeful that this new year will show even greater increases in all classes of affiliation.

Schedule of ASTM Meetings

This gives the latest information available at ASTM Headquarters. Direct mail notices of all district and committee meetings customarily distributed by the officers of the respective groups should be the final source of information on dates and locations of meetings. This schedule does not attempt to list all meetings of smaller sections and subgroups.

DATE	GROUP	PLACE
Jan. 25–27	Committee A-1 on Steel	Pittsburgh, Pa.
Jan. 27	Philadelphia District	Philadelphia, Pa.
Jan. 28–29	Committee B-4 on Electrical Heating Alloys	New York, N. Y.
Feb. 1–5	**ASTM Committee Week**	**Washington, D. C. (Shoreham Hotel)**
Feb. 10	Western New York-Ontario District	Buffalo, N. Y.
Feb. 12	St. Louis District	St. Louis, Mo.
Feb. 14–19	Committee D-2 on Petroleum	Philadelphia, Pa.
Feb. 15	Southwest District—Joint Meeting with NACE	Dallas, Texas
Feb. 15–17	Joint ASTM-TAPPI Committee on Petroleum Wax	New York, N. Y.
Feb. 17	Southwest District	Houston, Tex.
Feb. 18	Committee D-23 on Cellulose and Cellulose Derivatives	New York, N. Y.
Feb. 18–19	Committee D-6 on Paper and Paper Products	New York, N. Y.
	Committee B-9 on Metal Powders	New York, N. Y.
Feb. 23	Southern California District—Joint Meeting with AIChE	Los Angeles, Calif.
Feb. 25	Northern California District	San Francisco, Calif.
March 2	Washington-Oregon Area—Joint Meeting with AIChE and ASM	Richland, Wash.
March 4	Washington-Oregon Area Meeting	Seattle, Wash.
March 4	Committee E-2 on Emission Spectroscopy	Pittsburgh, Pa.
March 5–6	Committee E-13 on Absorption Spectroscopy	Pittsburgh, Pa.
March 6	Committee E-13 on Absorption Spectroscopy	Pittsburgh, Pa.
March 17	Philadelphia District—Joint Meeting with ACS	Wilmington, Del.
March 17–19	Committee D-13 on Textile Materials	New York, N. Y.
March 17–19	Committee D-15 on Engine Antifreezes	Washington, D. C.
March 22–23	Committee D-12 on Soaps and Other Detergents	New York, N. Y.
March 22–24	Committee D-20 on Plastics	Roanoke, Va.
March 24–26	Committee D-9 on Electrical Insulating Materials	Roanoke, Va.
March 31	Detroit District	Detroit, Mich.
June 13–18	**ASTM Annual Meeting (Eleventh Exhibit of Testing and Scientific Apparatus; Laboratory Supplies and Ninth Technical Photographic Exhibit)**	**Chicago, Illinois (Sherman and Morrison Hotels)**

Bibliographies of AEC Technical Reports Soon Available

A SERIES of bibliographies covering nonsecret reports on technological developments in the atomic energy program has been compiled by the Industrial Information Branch of the Atomic Energy Commission.

The first part, listing and abstracting from nearly 9000 technical reports those of special interest to the metallurgical and ceramics industries, is now available.

Other bibliographies scheduled to appear are:

Chemistry and Chemical Engineering
Construction and Civil Engineering
Electronics and Electrical Engineering
Health and Safety
Industrial Management
Mechanics and Mechanical Engineering
Mining and Geology
Nuclear Technology

Copies can be obtained from Industrial Information Branch, U.S.A.E.C., Washington 25, D. C.

District Activities

Districts Sponsor Student Membership Awards

Individual Members Also Continue Interest in Plan

SEVERAL of the ASTM Districts have been considering sponsoring Student Membership Prize Awards in schools in their respective areas, and the Philadelphia group will underwrite at least 27 of these awards in leading engineering schools in the Philadelphia District. The Pittsburgh Council also has a plan which is being projected to recognize outstanding students in four schools in that District.

This plan of recognizing work by students in engineering courses, particularly in subjects related to the work of the Society such as testing materials laboratory, metallurgy, resistances, mechanics, or in chemical laboratory work, etc., was started a number of years ago, and quite a few members have sponsored these awards. The member contributes $2 Student Membership dues, and the Headquarters Staff or the member arranges with the designated school to select the student.

The Award Plan is beneficial to the student because of publication privileges; it recognizes meritorious work, and acquaints the student with important activities in the field of materials.

Recently in Philadelphia the award winning students for last year at one school where the plan has been in effect for many years were recognized at one of the District Meetings. The current, greatly expanded program, headed by L. P. Mains, of Drexel Institute of Technology, with the cooperation of Percival Theel, of the Philadelphia Textile Inst., and the District Officers, envisages a special fall meeting at one of the local engineering schools at which all of the prize winners will be invited and be the guests of various District Councilors or members. An outstanding speaker will address the group after the award ceremonies are completed.

There follows a list of the schools at which prize award plans are in effect for this school year, with the names of the donors. The number of awards totals 103:

University of California, Berkeley, Calif.—*Bertram F. Kline*
University of California, Los Angeles, Calif.—*E. O. Slater*
California State Polytechnic College, San Luis Obispo, Calif.—*Martin Mahler*
University of Colorado, Boulder, Colo.—*Glenn Murphy*
University of Delaware, Newark, Del.—*Philadelphia District*
George Washington University, Washington, D. C.—*Martin Mahler*
Purdue University, Lafayette, Ind.—*C. H. Fellows*
Iowa State College, Ames, Iowa—*Hugh Bigler*
Worcester Polytechnic Institute, Worcester, Mass.—*Simon Collier*
Princeton University, Princeton, N. J.—*Philadelphia District*
Columbia University, New York, N. Y.—*James T. Kemp*
Rensselaer Polytechnic Institute, Troy, N. Y.—*R. J. Painter*
Ohio Northern University, Ada, Ohio—*Robert S. Armstrong*
University of Toledo, Toledo, Ohio—*C. R. Muenger*
University of Oklahoma, Norman, Okla.—*C. W. Armstrong*
Lehigh University, Bethlehem, Pa.—*Philadelphia District*
Lafayette College, Easton, Pa.—*Martin Mahler*, also *Philadelphia District*
Bucknell University, Lewisburg, Pa.—*Philadelphia District*
Drexel Institute of Technology, Philadelphia, Pa.—*Philadelphia District*
Drexel Evening College, Philadelphia, Pa.—*Philadelphia District*
University of Pennsylvania, Philadelphia, Pa.—*Philadelphia District*
Philadelphia Textile Inst., Philadelphia, Pa.—*Philadelphia District*
Carnegie Institute of Technology, Pittsburgh, Pa.—*Pittsburgh District*
University of Pittsburgh, Pittsburgh, Pa.—*Pittsburgh District*
Pennsylvania State University, State College, Pa.—*Pittsburgh District*
Swarthmore College, Swarthmore, Pa.—*Philadelphia District*
Villanova University, Villanova, Pa.—*Philadelphia District*
Tennessee Agricultural and Industrial State University, Nashville, Tenn.—*Martin Mahler*
West Virginia University, Morgantown, W. Va.—*Pittsburgh District*
University of Lausanne, Lausanne, Switzerland—*Anonymous*

Other members and districts who are interested are urged to consider this Student Membership Prize Award plan. The number of awards sponsored by various individuals ranges from one to ten. Headquarters will be glad to furnish information to anyone interested.

President Beard to Speak at Southwest and West Coast District Meetings

ASTM President L. C. Beard, Jr., who has spoken before very successful meetings of the New York, Pittsburgh, and Ohio Valley Districts, has now completed his itinerary for a swing through the Southwest and West Coast areas.

Accompanied by ASTM Executive Secretary, R. J. Painter, Dr. Beard will speak before the Western New York-Ontario District on February 10, will then be in St. Louis on the 12th, arriving in the Dallas-Fort Worth area of the ASTM Southwest District on February 15 where he will speak before a joint ASTM-NACE group. On February 17 Messrs. Beard and Painter will address the Southwest District in Houston.

Dr. Beard will address the Southern California District in Los Angeles on February 23 at a meeting co-sponsored with the American Institute of Chemical Engineers and will then move up to San Francisco for a meeting of the Northern California District on February 25.

Although there is no ASTM district which includes the Pacific Northwest, very successful meetings have been held in the Richland, Wash., area in conjunction with the American Society for Metals. A similar meeting will be held under the same auspices this year on March 2 and then Dr. Beard will make an additional address in this area at Seattle on March 4.

On March 17 the Philadelphia District will join the ACS Delaware Section in sponsoring a meeting at Wilmington, Del., at which time the President will be the featured speaker.

The Philadelphia District is also sponsoring a dinner meeting January 27 to hear Robert C. McMaster speak on "Non-Destructive Testing." The coffee speaker at this meeting will be Marvin Halbert, Assistant District Attorney, who will address the group briefly on "A Day with the D.A."

C. R. Gillette Speaks to New York District on Rust Prevention

C. R. Gillette, Chief Chemist of the New Departure Div., General Motors Corp., and Past-Chairman, Connecticut Section, ASLE, spoke to 150 members and guests of ASTM and the American Society of Lubricating Engineers at a meeting in New York City on November 18.

C. R. Gillette

Mr. Gillette's talk on "Rust Prevention Practices in Manufacturing Operations" reviewed an extremely important but frequently overlooked phase of manufacturing operations, namely, the protection of finished surfaces through the stages of machining, assembly, storage, and end use. The high degree of precision required in the anti-friction bearing industry has resulted in extensive studies in this field, and Mr. Gillette's comments, based on the results of these studies, were highly interesting to the people in the fields where machined metal surfaces are manufactured or employed.

An extensive discussion period followed the talk and included such items as effects of perspiration from the hands of those handling articles with machined metal surfaces, the use of various types of rust preventive oils, and the effect of surface finish on corrosion and resistance.

Prior to the meeting, the local ASTM council and ASLE officers and directors met at a dinner held in the famous Luchow's Restaurant. ASTM New York District officers were Chairman G. O. Hiers, Vice-Chairman E. P. Pitman, and Secretary A. A. Jones. Those from ASLE included National President Campbell and Section officers Chairman A. M. Southcott, Treasurer Erwin Landau, and Program Chairman C. T. Stone.

Statistics Course for Industrial Research Workers

During the spring quarter of 1954 (March 24 to June 4) the Institute of Statistics of the University of North Carolina will sponsor a special program of course work, lectures, and seminars on statistics for research engineers, physicists, and chemists. The primary objective of this program is to provide an opportunity for industrial research workers to acquire a working knowledge of modern statistical concepts and techniques. Emphasis will be on the efficient design of experiments and the analysis of data therefrom. Informal seminars on statistical problems submitted by the participating students will be held. Guest lecturers will include W. J. Youden and M. G. Kendall. Regular college credit will be granted for course work satisfactorily completed.

For further information write to Institute of Statistics, North Carolina State College, Box 5457, Raleigh, N. C.

Symposium and Banquet to Honor A. E. White

ASTM Past-President A. E. White will be honored on the occasion of his 70th birthday by the holding of a Symposium on the Utilization of Heat Resistant Alloys at the University of Michigan, Ann Arbor, March 11 and 12.

The four sessions of the symposium are headed General Principles, Engineering Practice in Design and Selection of Materials, Production and Fabrication Aspects, and Metallurgical Variables—Specification and Acceptance Testing. A number of the papers in these sessions are by active ASTM members who are specialists in this important and rapidly growing field. The program is designed as a review of the adaptation of latest theoretical and practical knowledge to present-day engineering problems.

On Thursday evening, March 11, a banquet in honor of Professor White will be held. Further information may be obtained from Professor C. A. Siebert, Department of Chemical and Metallurgical Engineering, University of Michigan, Ann Arbor, Mich.

ISCC Urges Caution in Use of Unscientific Corrosion Prevention Devices

[Ed. Note.—Publication of this article was advocated by the ASTM Advisory Committee on Corrosion.]

The Inter-Society Corrosion Committee has become greatly concerned about the hazards which may result from dependence on certain unproved devices for controlling corrosion and scaling and recommends that caution be exercised in the application of such devices. Failure to give protection may result in serious damage to expensive equipment where a real problem of corrosion or scaling exists.

The Inter-Society Corrosion Committee is made up of about 35 delegates from major technical societies, in the United States and Canada, actively concerned with problems of corrosion control and with the scientific reduction of the economic loss caused by corrosion. By means of this word of caution, and in accordance with its established objectives, the committee seeks to promote the use of the many scientifically sound and effective devices and processes which are presently available and to discourage dependence on unsound and ineffective methods of control.

The committee wishes to draw particular notice to devices that are not based on any understandable scientific principle and which are generally promoted on the basis of testimonials from presumably satisfied customers, unsupported by quantitative data. Special attention is drawn to supposedly scientific explanations which make liberal and incoherent use of such terms as catalysis, magnetism, electronics, radiation, etc. Such "explanations" do not appear to have any basis in scientific fact.

In some cases recommendations are made by manufacturers that grounding wires of electrical circuits, if unfavorably connected to pipes in which the devices are installed should be rearranged or connected elsewhere. The committee emphasizes that if, because of installation of or after one of these devices has been installed, the electrical circuits are not grounded in accordance with the National Electrical Code, serious impairment of the safety of persons and property may result.

Against this background, and in line with its responsibilities, the committee then recommends extreme caution in the application of devices for control of corrosion and scaling that are characterized by supposed operation without any apparent basis of sound scientific principles and for which no adequate engineering performance data are available.

Technical Committee Notes

Acoustical Materials—Testing Methods—Quality Control—Effect of Temperature

Acoustical Materials

Specifications for Acoustical Materials Adhesive Near Completion

A PROPOSED specification for adhesives for acoustical materials was agreed upon at the meeting of Committee C-20 held at ASTM Headquarters in Philadelphia on December 8 and 9. The new specification includes requirements for composition of the adhesive, toxicity, workmanship, consistency, strength, and wetting properties. Further study will be made on a proposal to include a method for measuring aging. The adhesive described is intended for bonding prefabricated acoustical materials to inside walls and ceilings of rooms in buildings. A joint task group has been organized with Committee D-14 on Adhesives, which has been interested in this type of specification and will jointly recommend a specification to the Society for acceptance.

Impedance and Absorption Test

A comprehensive method of test for impedance and absorption properties of acoustical materials by the tube method will be published as an appendix to the 1954 Annual Report of the committee, and in a condensed form, this method will be prepared for presentation to the Society as a proposed tentative method. Also in the field of sound absorption tests, a report was made on the status of the reverberation chamber method, noting that round-robin test data have now been accumulated and are being analyzed. A draft of a proposed box method will be prepared for the next meeting, at which time test data will be completed and studied to establish the justification for utilizing this type of method. A close-up method for use on the job is being developed at the National Bureau of Standards. A variation of the impedance tube method has been studied by the National Research Council of Canada, the advantage of this modification being that it can measure a full square-foot sample. A third type of test, under study at Massachusetts Institute of Technology is known as the shallow duct method, with which it is possible to measure several square feet of acoustical material.

The first draft of a method for determining flame spread or flame resistance of acoustical materials has been prepared, this being a modification of the method now prescribed in the Federal Specification SS-A-118a. This draft has been prepared after a study of data obtained at the Riverbank Laboratory.

Maintenance of Acoustical Materials

A third draft of a laboratory procedure for painting acoustical materials was reviewed. This test method is for the purpose of comparing the paintability of different acoustical materials, using the same type of paint, and the effectiveness of different types of paint. After certain additional data have been obtained for establishing a better basis for determining the light reflection coefficient, the proposed method will be circulated for subcommittee letter ballot. Two other projects related to maintenance are a proposed staining test and a washability test, both of which are being prepared for further review.

A comprehensive group of methods has been prepared for evaluating the physical properties of architectural acoustical materials relating to strength. Procedures are included for determining structural hardness, abrasive resistance, sag, linear expansion and contraction, and transverse strength. A new draft will be circulated for subcommittee letter ballot, which will include a statement on the significance of each test. Additional basic physical properties under study include flow resistance and light reflectance.

The next meeting of the committee will be held on May 13 and 14 at Madison, Wis.

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Methods of Testing

Subcommittees on Laboratory Apparatus Meet in Philadelphia

MEETINGS of five subcommittees dealing with laboratory apparatus, of Committee E-1 on Methods of Testing, were held at Society Headquarters on November 30 to December 3.

Thermometers

At the meeting of Subcommittee 17 on Thermometers, a new task group was appointed to prepare specifications for thermometers for solidification point determination of chemicals, such as benzol, naphthalene, and phenol. This same task group was also given an assignment to prepare specifications for thermometers suitable for use in the Test for Distillation of Industrial Aromatic Hydrocarbons (D 850). The subcommittee considered at length a proposal for a new method of specifying the detailed dimensions of thermometers which would contemplate specifying the length of the graduated temperature scale and also the distance from the top graduation to the top of the thermometer together with an over-all length of the thermometer. In the present specifications it is customary to specify the over-all length and the distances from the bottom of the thermometer to the lowest graduation, and from the top of the thermometer to the upper graduation. The committee decided to arrange for the manufacture of several specimen thermometers graduated by both methods, for review and study at the next meeting.

Action was taken to revise the ASTM Open Flash Thermometer 11C to require graduations to be numbered at each multiple of 20 C rather than every 10 C as specified.

A task group was appointed to consider the type of glass used for thermometers having an upper temperature of around 400 C. The thermometric glass tubing customarily used may not be too stable at this high temperature for any length of time.

Hydrometers

Subcommittee 18 on Hydrometers at its meeting reviewed the recently issued Tentative Specifications for ASTM Hydrometers (E 100). These specifications present in tabular form detailed purchase requirements for a series of API gravity hydrometers of two types, the long plain form, and the short plain form. There are ten hydrometers of the long plain form each covering a 12-deg interval over the API gravity range from −1 to +101. The hydrometers of the short plain-form type comprise 20 hydrometers each covering a 6-deg interval over the API gravity range 0 to 101 deg API. Also included are requirements for API gravity thermo-hydrometers of two types, one with the thermometer scale in the body, and the other with the thermometer scale in the stem. In addition, this standard includes two hydrometers used in testing soils. These new specifications answer a need for detailed requirements for a wide variety of standard hydrometers. They are expected to be widely used. The Petroleum Committee in its methods of test for API gravity is now specifying that the hydrometers used in the methods should conform to Specifications E 100.

At the meeting, the subcommittee considered specifications for specific gravity hydrometers which, after further review and approval, will be incorporated in Specifications E 100. Work is also being initiated on the preparation of methods of testing hydrometers.

Subcommittee 19 on Laboratory Glassware Apparatus reviewed at its meeting a proposed draft of a new standard covering apparatus for determining the water content of petroleum products and bituminous materials. This covers largely apparatus used in connection with ASTM Method D 95 and related methods in which the same type of apparatus is used. It will also include certain pieces of metalware apparatus developed in cooperation with Subcommittee 21. After review by the other interested technical committee it is proposed to submit this for publication as tentative at which time the detailed description of the apparatus will be eliminated from Methods D 95 and replaced by reference to this new tentative.

The subcommittee also reviewed a similar draft of a proposed standard covering apparatus used in the Engler distillation methods such as ASTM Standards D 86 and D 216. After review of this proposal by the interested committees it is also expected that this detailed description of the glassware apparatus used in these distillation tests will be published as tentative with corresponding changes and references being made in the distillation methods.

Subcommittee 21 on Metalware Laboratory Apparatus considered details for the ring and ball as well as the compaction apparatus used in the Ring-and-Ball Softening Point Methods E 28 and D 36. The committee also reviewed a draft of proposed performance specifications for analytical balances which had been prepared by Subcommittee G-2, of Committee E-3 on Methods of Chemical Analysis of Metals. Work is under way by a task group on the preparation of specification requirements for laboratory ovens. This task group plans to have a meeting in Washington during ASTM Committee Week, the week of February 1. Other matters considered by the subcommittee were metalware apparatus used in the flash point test, vapor pressure equipment, and Engler viscosity apparatus. It also has under consideration the preparation of proposed manufacturing specifications for oxygen and peroxide bombs to insure safe practice.

Subcommittee 26 on Filtration Materials reviewed in detail at its meeting the third draft of the proposed Tentative Methods of Test for Rigid Porous Filters for Laboratory Use. These test methods cover rigid elements used for filtering or diffusion, such as those made of sintered glass, ceramic, metal, or plastic for laboratory use; they provide a standard method for the determination of maximum pore diameter and permeability of such filters and establish a uniform designation for these characteristics by which the user may select the grade of filter best suited to his requirements.

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Quality Control of Materials

Bulk Sampling Subgroups Outline Extensive Program

This committee is planning to sponsor a Symposium on Statistical Design of Experiments as one of the features of ASTM Committee Week at the Shoreham Hotel, Washington, D. C., Feb. 1–5, 1954. It is planned to have the symposium on Tuesday evening February 2. Arrangements for the symposium were completed at a meeting of Committee E-11, held in Philadelphia on November 17. The symposium will comprise the following papers:

The Purpose of Experimental Design—W. G. Cochran, Johns Hopkins University

An Engineering Application of Experimental Design—Besse B. Day, F. R. Del Priore, Naval Experimental Station

Design of Experiments and Physical Sciences—W. J. Youden, National Bureau of Standards

Members of ASTM Committee E-11 meeting at Headquarters in Philadelphia are, left to right: John H. Curtiss, National Bureau of Standards; Louis Tanner, U. S. Customs Lab.; Oliver P. Beckwith; William J. Youden, National Bureau of Standards; Harold F. Dodge, Bell Telephone Laboratories, Inc.; R. H. Ede, U. S. Steel Co.; Grant Wernimont, Eastman Kodak Co.; Arthur G. Scroggie, Jr., E. I. du Pont de Nemours & Co., Inc.; Gerald J. Lieberman, Stanford University.

A survey of the sampling requirements appearing in ASTM standards was completed some time ago by a task group. This information is now being reviewed as a basis for an article to be published in a future issue of the ASTM BULLETIN.

The Task Group on Planning Interlaboratory Test Programs reported that the third draft of a Proposed Recommended Practice for Conducting an Interlaboratory Study of a Test Method is nearing completion. It is expected that this draft will be available for review prior to the next meeting of the committee.

Another task group reported that a final draft of a Proposed Recommended Practice for Number of Tests for a Desired Precision of an Average was undergoing further review, and when this is completed it would be submitted to the committee.

The scope of the Task Group on Bulk Sampling includes a study of the problems of sampling materials that occur in bulk form or in packages with the aim of estimating a minimum cost measurable characteristics of a quantity of material in order to get minimum prescribed limit of error with an assigned probability. Work on this subject has been subdivided among several groups.

The Subgroup on Standards of Sampling of Materials has two assignments: (*a*) to prepare standards by which to judge whether specific procedures for drawing and for estimating from samples various characteristics of a lot of physical material, are statistically biased or unbiased, and whether they will provide a valid standard error, and (*b*) to prepare standards for the presentation of the results of tests made on a sample to determine one or more characteristics of a lot of physical material.

The Subgroup on Handling of Materials has four assignments: (1) To discover ways in which samples may be drawn from materials as they are now handled, and to do so economically and with conformance to statistical procedures. (2) To discover possible changes that may be made in present practices of handling certain materials, in order to make statistical samples possible at costs not too great. The great difficulty is the definition of some economical sampling unit, and the drawing thereof by random numbers. The extra accuracy of the statistical sample, and the reduced size of sample required, will sometimes more than pay the additional cost of the change in handling. (3) To study the biases that arise from judgment selections. (4) To study the possible improvement that may result in special cases from a random drawing of those articles, cases, sacks, etc., which are on the top and outside of a pile, or which are otherwise easily accessible.

There are three other subgroups whose assignments are to assist other ASTM committees, arrange for occasional symposiums on the sampling of materials, and to prepare papers on the theory and practice of the sampling of particular materials.

The Subgroup on Precision and Accuracy submitted a preliminary draft which discussed such terms as (1) measurement, (2) real-life and exemplar measurement process, (3) precision and accuracy, (4) mathematical models of stable measurement processes, and (5) mathematical models of unstable measuring processes. This draft will receive further study by the committee.

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Effect of Temperature on Properties of Metals

New Publications and Symposiums Planned Reflect High Level of Activity

ONE of the most productive panels of the ASTM-ASME Joint Committee on Effect of Temperature on the Properties of Metals which met in New York City, December 1–3, during the ASME Annual Meeting, is the Data and Publications Panel which has now completed and published the third in its series of surveys on the elevated-temperature properties of specific families of metals—"The Elevated-Temperature Properties of Chromium-Molybdenum Steels," *ASTM STP No. 151*. This new report was preceded by "The Elevated-Temperature Properties of Stainless Steels," *ASTM STP No. 124*. The so-called Heger-Miller Report was the first of the series and was published as an interim report designed only to fill a temporary gap until more complete surveys such as *ASTM STP Nos. 124* and *151* became available.

Following the next publication on Super-Alloys will be the Survey of Copper-Base Alloys, the Survey of Relaxation Data, and the Survey of Strength of Weldments, in that order.

Data are now being solicited in connection with the new survey designed to collect data on bolting steels and other steels not included in any previous surveys.

Other suggested surveys to be considered at a later date include those on aluminum and magnesium alloys, on titanium and titanium alloys, and on "cermets."

Low-Temperature Panel

High on the list of accomplishments of the committee's Low-Temperature Panel was the Symposium on Effect of Temperature on the Brittle Behavior of Metals with Particular Reference to Low Temperatures, held at the 1953 Annual Meeting of the Society. Work is now underway on the preparation of the symposium papers for publication. Anticipated size of this publication is about 525 pages, and it should be available sometime in March.

The panel is investigating the feasibility of having a monograph prepared on fracture properties of metals between 100 F and absolute zero.

In addition to the numerous surveys conducted by the Data and Publications Panel as related to the elevated-temperature properties of materials, the Low-Temperature Panel is recommending that the Data and Publications Group undertake a survey on the physical properties of materials at low temperatures, to be published in a manner similar to *STP Nos. 124* and *151*.

General Research Panel

The General Research Panel is cosponsoring three symposiums. A two-session Symposium on Effect of Cyclic Heating and Stressing on Metals at Elevated Temperatures will be presented at the 1954 ASTM meeting in Chicago, Ill. The second, Basic Effects of Environment on Strength, Scaling or Embrittlement of Metals at Elevated Temperatures will be presented during the 1955 ASTM Committee Week in Cincinnati, Ohio. The Symposium on Metallic Materials for Service Above 1600 F will be held at the 1955 ASTM Annual Meeting. This symposium is expected to cover, in addition to strictly metallic materials, the recently developed "cermets."

In addition to these symposiums the General Research Panel is investigating the possibility of sponsoring a fellowship to study research on the fundamental concept of creep.

The Joint Committee agreed to discharge with thanks Project 29 on "Stability of Steels as Affected by Temperature."

The other primary question before the Joint Committee is its desire to have developed a recommended practice for pyrometry. This has been referred to Committee E-1 on Methods of Testing for appropriate action, but a special task group has been set up within the Joint Committee in an effort to effect interim temporary procedures.

25 Year Members

THE Board of Directors wishes to recognize long time affiliation with the Society and accordingly it is proposed to record the completion of twenty-five years membership in the Society. In initiating this practice the names of all members who have been associated with the Society for twenty-five years or more are listed below with the exception of forty year members and fifty year members whose names are listed in the current Year Book of the Society on page 198. In the future it is planned to publish the names of members as they complete twenty-five years of membership.

A

AC Spark Plug Division, General Motors Corp., 1924
Abson, Gene, 1928
Acme Paint and Varnish Co., Ltd., 1924
Acme Steel Co., 1927
Adams, Comfort A., 1920
Adelson, J. S., 1928
Adler, Julius, 1915
Akron, University of, Bierce Library, 1915
Allen, H. S., 1928
Allen, Russell J., 1926
Allentown, City of, Department of Streets and Public Improvements, 1927
Allentown Portland Cement Co., 1927
Alpha Portland Cement Co., 1915
Alten, George H., 1928
Altos Hornos de Vizcaya, S. A., 1929
Aluminum Company of America, 1917
American Brass Co., The, 1928
American Bridge Division, United States Steel Corp., 1920
American Cast Iron Pipe Co., 1917
American Ceramic Society, Inc., 1921
American Chain and Cable Co., Inc., 1916
American Concrete Pipe Assn., 1916
American Cresote Works, Inc., 1929
American Creosoting Co., 1928
American Cyanamid Co., 1927
American Enka Corp., 1929
American Hard Rubber Co., 1920
American Institute of Architects, Cincinnati Chapter, The, 1916
American Manganese Bronze Co., 1916
American Metal Co., Ltd., The, 1916
American Metal Market, 1924
American Pipe and Construction Co., 1916
American Smelting and Refining Co., 1926
American Tar Co., 1924
American Viscose Corp., 1925
American Zinc Inst., Inc., 1922
American Zinc, Lead and Smelting Co., 1928
Ammann, O. H., 1920
Amsler and Co., Alfred J., 1920
Amthor, F. E., 1926
Anaconda American Brass, Ltd., 1924
Anaconda Copper Mining Co., 1929
Anaconda Copper Mining Co., Great Falls Reduction Dept., 1920
Anderegg, F. O., 1929
Ann Arbor, City of, 1927
Appel, William D., 1929
Arizona State Highway Dept., 1919
Arkansas, University of, 1926
Armstrong Cork Co., 1924
Arndt, Alfred F., 1922
Asphalt Roofing Industry Bureau, 1924
Atlas Powder Company Library, 1921
Austin, Arthur O., 1916
Austin, City of, 1928
Australia, Standards Association of, 1928
Avery, Ltd., W. & T., 1918
Ayres, Louis E., 1921

B

Babcock & Wilcox Co., The, 1915
Babcock & Wilcox Co., The, Tubular Products Division, 1922
Bachman, B. B., 1919
Bain, Edgar C., 1924
Baker and Co., Inc., 1929
Baker, R. J., 1928
Ball, Herbert J., 1929
Baltimore, City, of, Bureau of Tests, 1923
Baltimore & Ohio Railroad Co., The, 1919
Bareco Oil Co., 1921
Barnes - Gibson - Raymond, Division of Associated Spring Corp., 1929
Barr, William M., 1922
Barrow-Agee Laboratories, Inc., 1924
Bayless, Ray T., 1919
Baylis, John R., 1926
Bell Telephone Laboratories, Inc., 1925
Belling, Ejnar, 1928
Bemis Bro. Bag Co., 1923
Bibb Manufacturing Co., 1925
Binney & Smith Co., 1924
Birmingham, City Engineer, 1927
Birmingham Public Library, 1922
Birmingham Slag Co., 1917
Birmingham, University of, Library, 1923
Bissell, Clinton T., 1929
Blank, Alton J., 1927
Blum, William, 1929
Bogert, Clinton L., 1929
Bohn Aluminum and Brass Corp., 1918
Bolton, J. W., 1926
Bonney-Floyd Co., The, 1925
Bonney, Robert D., 1919
Bornstein, Hyman, 1915
Boston Edison Co., 1921
Boston & Maine Railroad, 1916
Bowdry William P., Jr., 1928
Bowles, James T-B., 1921
Bowser-Morner Testing Laboratories, 1929
Braden Copper Co., 1927
Bragg, J. G., 1918
Branson, Edward H., 1929
Brass and Bronze Ingot Inst., 1929
Bratt, Albert V., 1921
Braun and Co., C. F., 1927
Breth, F. W., 1923
Brewer, J. E., 1924
Breyer, Frank G., 1928
Bridgeport Public Library and Reading Room, 1921
Bristol Brass Corp., The, 1913
Bristol, University of, University Engineering Labs., 1927
British American Oil Co., Ltd., The, 1923
British Cast Iron Research Assn., 1922
British Columbia, University of, Library, 1926
British Cotton Industry Research Assn., 1923
British Electrical and Allied Industries Research Assn., The, 1921
British Naval Attaché, 1929
Broken Hill Associated Smelters, Proprietary, Ltd., The, 1917
Brooklyn Union Gas Co., The, 1928
Brossman, Philip D., 1925
Brown, Arthur F., 1921
Brown, Robert H., 1918
Brown, Wilbur F., 1926
Bucknell University, 1927
Bucy, Edmond H., 1929
Bucyrus-Erie Co., 1924
Budd Co., The, 1921
Budd Co., The, 1926
Buffalo, City of, Division of Engineering, 1929
Buffalo Slag Co., Inc., 1923
Burbidge, A. F., 1925

C

Cairo Chemical Dept., 1924
Calef, J. F., 1921
California Institute of Technology, 1921
California Portland Cement Co., 1928
California State Department of Public Works, Division of Architecture, 1920
Camden Forge Co., 1918
Campbell, Sumner E., 1916
Campen, W. H., 1919
Canada Cement Co., Ltd., 1919
Canada Department of Mines and Technical Surveys, Mines Branch, 1921
Canada Forest Products Laboratory, Department of Resources and Development, 1915
Canadian-Brazilian Services, Ltd., 1921
Canadian Car and Foundry Co., Ltd., 1926
Canadian General Electric Co., Ltd., 1916
Canadian Locomotive Co., Ltd., 1917
Canadian National Railways, 1927
Canadian Standards Assn., 1927
Canfield Oil Co., The, 1922
Cann & Saul Steel Co., 1926
Carey Manufacturing Co., The Philip, 1922
Carnegie Free Library of Allegheny, 1919
Cavagnet, Lucien J., 1928
Celanese Corporation of America, Summit, N. J., 1925
Celanese Corporation of America, New York, N. Y., 1925
Central Scientific Co., 1917
Certain-teed Products Corp., 1915
Chapman, Edmund E., 1921
Chapman Valve Manufacturing Co., The, 1917
Chase Brass and Copper Co., Inc., 1920
Chesapeake & Ohio Railway Co., The, 1919
Chicago, City of, Department of Purchases, Contracts and Supplies, Testing and Inspection Div., 1925
Chile Exploration Co., 1925
Chile, University of, Laboratory for Testing Materials, 1917
Chubb, Joseph H., 1921
Cincinnati, City of, Municipal Reference Bureau, 1929
Cincinnati Milling Machine Co., The, 1926
Cincinnati, University of, General Library, 1926
Cities Service Co., 1924
Cities Service Oil Co., 1920
City and Guilds College Library, 1919
Clark, C. B., 1917
Clark, Claude L., 1929
Clark, K. A., 1915
Clarvoe, George W., 1928
Clauser, John M., 1924
Clay Products Assn., 1918
Clayden, A. Ludlow, 1924
Clemmer, Harold F., 1915
Clemson Agricultural College Library, 1924
Cleveland Electric Illuminating Co., The 1924
Cleveland Public Library, 1927
Cleveland Twist Drill Co., The, 1920
Climax Molybdenum Co., 1929
Collier, Simon, 1926
Colorado Fuel and Iron Corp., The Wickwire Spencer Steel Division, Claymont Plant, 1919
Colorado School of Mines Library, 1926
Columbia-Geneva Steel Division, United States Steel Corp., 1919
Columbia University, Civil Engineering Research Laboratories, 1918
Colwell, Donald L., 1927
Concrete Products Company of America, 1915
Concrete Reinforcing Steel Inst., 1926
Connecticut State Highway Department, 1920
Connors Steel Co., 1926
Conrow, Aubrey D., 1926
Consolidated Edison Company of New York, Inc., 1920
Consolidated Mining and Smelting Co. of Canada, Ltd., The, 1916
Continental Can Co., Inc., 1928
Continental-Diamond Fibre Co., 1927
Continental Foundry and Machine Co., 1916
Continental Oil Co., 1922

Conzelman, Joseph H., 1927
Cook, Nelson E., 1925
Cook Paint and Varnish Co., 1920
Copenhagen Royal Technical College, 1929
Coplay Cement Manufacturing Co., 1923
Copper & Brass Research Assn., 1923
Cornell University, School of Chemical Engineering, 1920
Cowdrey, Irving H., 1915
Cox, S. Frank, 1923
Crepeau, Roy C., 1928
Crepps, Ray B., 1920
Crown Cork and Seal Co., Inc., 1920
Crucible Steel Company of America, 1928
Curtis, Harvey L., 1923
Cushing, Daniel, 1918
Cutler, H. J., 1924

D

Dambrun, Carl W., 1924
Danse, L. A., 1917
Darden, C. M., 1927
Darling Valve and Manufacturing Co., 1924
Davidson, Earl H., 1928
Davis, Harmer E., 1928
Davis, Herbert A., 1920
Davis, Raymond E., 1922
Davis, Watson, 1918
Day, W. E., Jr., 1923
Dayton Engineers' Club Library, 1925
Dayton Public Library, 1929
Deans, R. Robertson, 1915
DeCastro, M. A., Teixeira, 1928
Deep Rock Oil Corp., 1925
Deere and Co., 1915
Deker, Frank G., 1929
Delaware State Highway Dept., 1922
Delaware, University of, Department of Mechanics, 1917
Delbridge, T. G., 1919
Delco Appliance Division, General Motors Corp., 1918
Delco-Remy Division of General Motors Corp., 1924
Dentler, Arnold E., 1928
Denver Public Library, Science and Engineering Department, 1924
Department of Scientific and Industrial Research, 1922
Desrosiers, P. H., 1927
Detroit, City of, Board of Water Commissioners, 1928
Detroit, City of, Department of Purchases and Supplies, 1927
Detroit Edison Co., The, 1916
Detroit Public Library 1925,
Diana, Frank B., 1925
District of Columbia Engineer Department 1929,
Dix, Edgar Hutton, Jr., 1919
Dixon, Enslo Smith, 1925
Doehler-Jarvis Division, National Lead Co., 1928
Dominion Foundries and Steel, Ltd., 1917
Downingtown Iron Works, Inc., 1929
Dragon Cement Co., Inc., 1928
Drake, Robert Zale, 1925
Drexel Institute of Technology, 1920
Driver-Harris Co., 1919
Duff, Carl M., 1921
Duke Power Co., 1922
Duke University Library, 1926
Duncan, Malcolm, 1918
Dunwody, K. W., 1927
du Pont de Nemours and Co., Inc. E. I., 1919
du Pont de Nemours and Co., Inc., E. I., Grasselli Chemical Dept., 1926
du Pont de Nemours and Co., Inc., E. I., Pigments Dept., 1915
du Pont de Nemours and Co., Inc., E. I., Textile Fibers Dept., Textile Research Div.. 1925
Duquesne Slag Products Co., 1916
Durez Plastics and Chemicals, Inc., 1928
Duriron Co., Inc., The, 1925
Dwyer, John R., 1920
Dyer Quarry Co., The John T., 1928

E

Eckert, Clarence R., 1924
Ecole Polytechnique, 1915
Edgewater Steel Co., 1928
Edlund, D. L., 1928
Egloff, Gustav, 1926
Eisenhard, Lewis A., 1916
Eksergian, C. L., 1929
Eldridge, G. S., 1925
Electric Storage Battery Co., The, 1923
Electro Metallurgical Division, Union Carbide and Carbon Corp., 1923
Electrolytic Refining and Smelting Company of Australia, Pty., Ltd., 1923
Emerson, Charles J., 1920
Emmons, Claude Edward, 1928
Ensign-Bickford Co., The, 1923
Epstein, Samuel, 1929
Erie Bolt and Nut Co., 1927
Erie Forge Co., 1915
Erie Railroad Co., 1919
Ethyl Corp., 1925

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Fahy, Frank P., 1917
Fairchild, I. J., 1922
Falls Hollow Staybolt Co., 1924
Faragher, Paul V., 1929
Farmer, F. Malcolm, 1921
Fay, Spofford & Thorndike, 1915
Federal-Mogul Research, Division of Federal-Mogul Corp., 1929
Federated Metals Division, American Smelting and Refining Co., 1929
Ferrell, K. P., 1927
Finkeldey, William H., 1925
Finkl and Sons Co., A., 1925
Firestone Tire and Rubber Co., The, 1916
Fleming, Arthur Percy Morris, 1916
Flood, Walter H., 1915
Ford, James G., 1926
Ford Motor Co., 1924
Foreman, Charles L., 1928
Formica Co., The, 1928
Foster, Alexander, Jr., 1929
Francis, Charles B., 1928
Francisco & Jacobus, 1926
Freedman, Ephraim, 1928
Freeman, John R., Jr., 1920
Freeman, Leopold, 1924
Freeman, Perry J., 1923
Fuel Engineering Co. of New York, 1928
Fuller, T. S., 1926
Fulton, A. Oram, 1925
Fulton Bag and Cotton Mills, 1923
Fulton Sylphon Division, The, Robertshaw - Fulton Controls Co., 1923

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Gaertner Scientific Corp., 1923
Garneau, Jean-Berchmans, 1924
Gauger, A. W., 1928
General Alloys Co., 1928
General Cable Corp., 1928
General Coal Co., 1926
General Electric Co., Lamp Dept., 1928
General Electric Co., Ltd., Witton Works, 1918
General Petroleum Corp., 1917
General Steel Castings Corp., 1920
General Tire and Rubber Co., The, 1926
Georgia, State Highway, Department of, 1919
Gerhart, W. Paul, 1925
Gilkey, Herbert J., 1924
Gill, James P., 1920
Gilmore, Ross E., 1927
Gladding, McBean and Co., 1925
Glens Falls Portland Cement Co., 1915
Glidden Co., The, Paint Divisions 1918
Globe Steel Tubes Co., 1927
Glover, James Bolan, 1928
Gough, Herbert John, 1926
Granite City Steel Co., 1918
Grant, Arthur A., 1929
Graves, W. H., 1923
Gray, Howard A., 1926
Greeley, Samuel A., 1926
Green Fire Brick Co., A. P., 1923
Green, Roy M., 1916
Greiner, Emil, Co., The, 1923
Grisbaum, Leonard, 1927
Grunewald, Max E., 1929
Gulf Oil Corp., Refinery Technology Laboratory, 1924

H

H-B Instrument Company, 1923
Haertlein, Albert, 1921
Hague, A. T., 1928
Hallenbeck, George S., 1928
Hamor, William A., 1922
Hancock, H. M., 1924
Harder, Oscar E., 1920
Harnischfeger Corp., 1929
Harriss, R. H., 1926
Harsch, John W., 1921
Hartford, City of, Department of Buildings, 1926
Hartford, City of, Department of Engineering, 1927
Harvey, Carl L., 1922
Haskell Manufacturing Co., William H., 1929
Hawkeye Portland Cement Co., 1923
Hazeltine, Harold L., 1919
Hebden, J. W., 1926
Heckel, James E., 1915
Hedderich, H. F., 1926
Heilman, R. H., 1929
Hercules Powder Co., 1921
Herzog, Max, 1919
Hess, Raymond E., 1921
Heuer, Russell P., 1924
Hiergesell, David, 1926
Hiers, George O., 1929
Hill Reference Library, James Jerome, 1923
Hindman, T. F., 1921
Hocker, Carl D., 1926
Holcomb, Edgar J., 1926
Hollingsworth & Vose Co., 1923
Hollister, S. C., 1917
Holt, L. T., 1920
Holz, Herman A., 1916
Hongkong, University of, 1926
Hood Rubber Co., Division of the B. F. Goodrich Co., 1921
Horvitz, Gerald J., 1923
Houston Public Library, 1921
Howell, Francis M., 1919
Howell, H. Clay, 1927
Hubbard, Fred, 1926
Hudson Wire Co., 1916
Hughes Tool Co., 1925
Hunt, Harvey Lee, 1929
Huntington, W. C., 1927

I

Idaho State Department of Highways, 1920
Idaho, University of, Civil Engineering Department, 1923
Illinois Institute of Technology, Armour College of Engineering, 1928
Illinois State Division of Highways, Bureau of Materials, 1926
Illinois State Library, General Library Division, 1922
Imperial Chemical Industries, Ltd., Billingham Division, 1925
Imperial Inst., The, 1918
Imperial Oil, Ltd., 1923
India, Forest Research Institute and Colleges of, 1921
Indiana Steel and Wire Co., 1925
Indianapolis Public Library, 1925
Industrial Rayon Corp., 1925
Inland Manufacturing Division, General Motors Corp., 1927
Inland Steel Co., 1917
Institute of Petroleum, The, 1922
Institution of Structural Engineers, The, 1926
Interlake Iron Corp., Toledo Furnace Plant, 1929
International Business Machines Corp., 1924
International Nickel Co., Inc., The, 1922
International Smelting and Refining Co., Raritan Copper Works, 1916
Iowa Malleable Iron Co., 1918
Iowa State Highway Commission, 1917
Irvington Varnish and Insulator Co., 1921
Istituto Scientifico Tecnico Ernesto Breda, 1926

J

Jackson, Frank H., 1916
Jacksonville, City of, 1927
Jacobi, Edward N., 1928
Jacobus, D. S., 1923
James, William S., 1922
Jameson, A. H., 1917
Janes, Arthur R., 1925
Jasper, T. McLean, 1924
Johannesburg Public Library, 1923
John Crerar Library, The, 1929
Johnson, A. S., 1928
Johnson Forge and Steel Corp., 1924
Johnson, George A., 1915
Johnson & Johnson, 1922
Johnson, L. E., 1927
Jones, Fred A., 1920

K

Kansas City Public Library, 1921
Kansas City Water Dept., 1923
Kansas State College of Agriculture and Applied Science, Road Materials Laboratory, 1921
Kansas State Highway Commission, 1919
Karlson, Charles B., 1929
Keasbey & Mattison Co., 1915
Keith, J. E., 1927
Kelley, Earl F., 1926

Kellogg, M. W., Co., The, 1918
Kellogg Switchboard and Supply Co., 1919
Kendall Refining Co., 1927
Kennecott Wire and Cable Co., 1924
Kentucky State Highway Dept., 1928
Kerite Co., The, 1916
Kessler, D. W., 1920
Ketterling, C. F., 1915
Keystone Portland Cement Co., 1929
Kimberly-Clark Corp., 1926
Kirschner, Jacob, 1928
Kjerrman, Bengt, 1925
Kolyn, M. D., 1925
Koninklijke/Shell Laboratorium, Bibliotheek, 1923
Koppers Co., Inc., Tar Products Division 1921
Kouwenhoven, William B., 1918
Kraemer, Albert J., 1926
Kraft, Christopher H., 1928
Kriege, Herbert F., 1927
Krimmel, Maxamillian A., 1923
Krug, Clarence Matthew, 1927

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Laclede Gas Co., 1923
Laclede Steel Co., 1923
Lafayette College, Civil Engineering Dept., 1928
Larson, Edward L., 1929
Larson, Louis J., 1928
Larsson, A. G., 1918
Latrobe Electric Steel Co., 1927
Laudig, J. J., 1921
Law, Thomas C., 1920
Leach, Robert H., 1926
Lebanon Steel Foundry, 1918
Lee, H. R., 1929
Leeds, University of, 1927
Legg, A. E., 1915
Lessells, John Moyes, 1924
Lever Brothers Co., 1927
Levinson, Arthur A., 1925
Lewin-Mathes Co., Lewin Metals Division, 1927
Lewis, Charles F., 1928
Link-Belt Co., 1923
Liverpool, University of, 1923
Lock Joint Pipe Co., 1918
Logan, Edgar H., 1926
Lone Star Cement Corp., 1919
Long Beach, City of, Chemical and Physical Testing Laboratory, 1927
Los Angeles, City of, Bureau of Standards, 1917
Los Angeles, City of, Department of Building and Safety, 1923
Los Angeles, City of, Department of Water and Power, 1929
Los Angeles Public Library, Serials Division, 1926
Louisiana State University, 1926
Louisville Cement Corp., 1920
Louisville & Nashville Railroad Co., 1918
Louisville, University of, Speed Scientific School, 1926
Loving, M. W., 1922
Lucas, E. A., 1929
Lucas, Joseph, Ltd., 1925
Luhrs, Albert W., 1921
Lunkenheimer Co., The, 1929
Lutts, Carlton G., 1918
Lux, G. A., 1928
Lynam, Charles H., 1927
Lyse, Inge, 1929
Lysle, F. B., 1915

M

MacKenzie, James T., 1918
Macomb, John de Navarro, 1922
Macon, City of, Engineering Dept., 1926
Madison-Kipp Corp., 1929
Magnus Metal Division, National Lead Co., 1918
Maine Technology Experiment Station, 1922
Malcolm, Vincent T., 1921
Manchester Public Libraries, 1925
Manchester, University of, 1928
Manitoba, University of, Engineering Library, 1921
Manning Paper Co., Inc., John A., 1924
Mansfield Tire and Rubber Co., The, 1920
Marathon Corp., 1928
Marblehead Lime Co., 1917
Markwardt, L. J., 1920
Marquette University, College of Engineering, 1921
Marsh, Lawrence S., 1917
Marshall, Charles H., 1919
Martin and Co., Charles, 1926
Massachusetts Institute of Technology, 1920
Massey Concrete Products Co., 1918
Matthis, A. R., 1922
Maynard Electric Steel Casting Co., 1925
McBurney, J. W., 1921
McEntire, Lloyd, 1916
McKay Co., The, 1919
McKay, Robert J., 1922
McMillan, F. R., 1919
McVetty, P. G., 1928
Mead, Dexter H., 1927
Medusa Portland Cement Co., 1923
Melbourne City Council, 1926
Menéndez, José, 1927
Meng, Alvord P., 1921
Merica, Paul D., 1915
Meriwether, C. E., Jr., 1929
Merrill, Alden, 1920
Mesta Machine Co., 1917
Metal Finishing, 1923
Mexico National School of Engineering, National University of Mexico, 1927
Mica Insulator Co., 1923
Michie, Arthur C., 1924
Michigan, University of, General Library, 1923
Michigan, University of, General Library, 1928
Mid-Continent Petroleum Corp., 1917
Miesenhelder, P. D., 1921
Miller, Albert E., 1926
Miller, Dalton G., 1924
Millot, André, 1921
Minnesota Department of Highways, 1920
Minnesota, University of, Library, 1922
Mississippi State Highway Department, 1920
Missouri-Kansas-Texas Railroad Co., 1918
Missouri Pacific Lines, 1921
Missouri State Highway Department, 1928
Missouri, University of, Engineering Library, 1921
Mitchell, Nolan D., 1923
Mittelman, L., 1927
Mochel, Norman L., 1929
Montana State Highway Department, 1919
Montgomery, W. J., 1920
Montreal, City of, 1925
Moody Engineering Co., 1915
Moore and Co., Benjamin, 1920
Moore, R. R., 1920
Morgan, H. H., 1924
Mougey, Harry Clifford, 1925
Mt. Vernon-Woodberry Mills, Inc., 1922
Muchnic, H. E., 1925
Murray, James A., 1928

N

NATCO Corp., 1915
Naegely, W. H., 1927
Narragansett Electric Co., 1916
National Association of Purchasing Agents, 1918
National Association of Wool Manufacturers, 1924
National Carbon Division, Union Carbide and Carbon Corp., 1922
National Cash Register Co., The, 1917
National Electric Products Corp., 1926
National Forge and Ordnance Co., 1926
National Gypsum Co., 1929
National Lumber Manufacturers Assn., 1917
National Malleable and Steel Castings Co., 1920
National Research Council of Canada, 1929
National Sand and Gravel Assn., 1924
National Supply Co., The Spang-Chalfant Division, 1919
National Vulcanized Fibre Co., 1928
Natural Gasoline Association of America, 1926
Nazareth Cement Co., 1925
Nellen, A. H., 1916
New England Brick Co., 1925
New England Power Service Co., 1929
New Hampshire, Department of Public Works and Highways, 1920
New Jersey Wood Finishing Co., 1927

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New South Wales, Department of Railway, 1923
New York Central System, 1919
New York City, Department of Purchase, 1920
New York Municipal Reference Library, 1925
New York, New Haven & Hartford Railroad Co., 1919
New York Public Library, Reference Dept., 1915
New York State Department of Public Works, Division of Construction, 1923
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New York Trap Rock Corp., 1928
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North Dakota State Highway Dept., 1926
North Jersey Quarry Co., 1921
Northeastern University, Department of Testing Materials, 1925
Northern States Power Co., 1919
Northwestern States Portland Cement Co., 1921
Notre Dame, University of, Department of Metallurgy, 1922
Noyes, E. N., 1925
Nutting, H. C., Co., 1921

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Ohio Brass Co., The, Barberton Division, 1916
Ohio Hydrate and Supply Co., The, 1923
Ohio Oil Co., The, 1927
Ohio Steel Foundry Co., The, 1921
Olds Motor Works Division, General Motors Corp., 1923
Oliensis, Gershon L., 1920
Olson, Joseph O., 1923
Omaha, City of, Building Dept., 1920
Ontario Department of Highways, 1916
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Pacific Gas and Electric Co., 1923
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Patton Clay Manufacturing Co., 1915
Paul, M. Rea, 1926
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Pennsylvania Forge Corp., 1916
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Perth City Council, 1926
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Phelps, S. M., 1923
Philadelphia, City of, Bureau of Highways, 1926
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Philadelphia Electric Co., 1922
Philadelphia, The Free Library of, 1921
Philadelphia Steel and Iron Co., 1926
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Pipe Fabrication Inst., 1927
Pitkin, Inc., Lucius, 1919
Pittsburgh-Des Moines Steel Co., 1923
Pittsburgh Piping and Equipment Co., 1925
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Pittsburgh Testing Laboratory, 1915
Pontiac, City of, 1927
Portland Cement Assn., 1916
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Portland Library Association of, 1922
Potomac Electric Power Co., 1920
Potter, H. V., 1927
Potthoff, K. T., 1917
Power, Henry Robert, 1916
Pratt Free Library, Enoch, 1926
Pratt & Letchworth Co., Inc., 1918
Precision Scientific Co., 1923
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Procter & Gamble Co., 1929
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Public Service Electric and Gas Co., 1924
Puerto Rico, University of, College of Agriculture and Mechanic Arts, 1926
Pullar, H. B., 1923
Purdy & Henderson Associates, Inc., 1922
Putnam, William James, 1918

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Quebec Department of Public Works, 1922

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Raber, Charles T., 1929
Rail Steel Bar Assn., 1926
Randall, W. Clifton, 1927
Raphael, A. L., 1929
Rawdon, Henry S., 1917
Reitze, Chester N., 1916
Research Association of British Paint, Colour and Varnish Manufacturers, The, 1928
Revere Copper and Brass Incorporated, 1927
Rhode Island Department of Public Works, Division of Roads and Bridges, 1915
Richardson Co., The, 1920
Richfield Oil Corp., 1929
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Ricketts, Edwin B., 1921
Riedel, John Charles, 1921
Rio de Janeiro Tramway, Light and Power Co., Ltd., The, 1924
Riverside Cement Co., 1923
Riverton Lime and Stone Co., Inc., 1920
Robbins, Frank M., 1927
Rochester, City of, Department of Public Works, Division of Engineering, 1919
Rochester Engineering Society, 1923
Rochester, University of, Library, 1923
Rockwood, Nathan C., 1919
Romaine, E. V., 1927
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Rose, Carlton H., 1929
Ross, Edgar S., 1923
Roth, Edward L., 1926
Russell, Burdsall & Ward Bolt and Nut Co., 1928
Ruwe, L. F., 1928

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S. A. des Chaux and Ciments de Lafarge et du Teil, 1924
Saathoff, George W., 1924
Safety Car Heating and Lighting Co., Inc., The, 1924
Sager, Theron P., 1919
St. Joseph Lead Co., 1919
St. Paul, City of, Bureau of Municipal Testing Laboratories, 1917
San Antonio Portland Cement Co., 1927
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Sanitary District of Chicago, 1927
Santa Cruz Portland Cement Co., 1916
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Sargent & Lundy, 1923
Saskatchewan, University of, Library, 1920
Sayre, Mortimer F., 1921
Schlick, W. J., 1920
Schlueter, W. A., 1922
Schmidt, Richard E., 1915
Scholer, E. E., 1927
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Scott, A. W., 1928
Scott Testers, Inc., 1915
Scovill Manufacturing Co., 1928
Seabord Air Line Railroad Co., 1918
Sears, Roebuck and Co., Department 817, Merchandise Testing and Development Laboratory, 1922
Seaside Oil Co., 1923
Seely, Fred B., 1915
Selvig, W. A., 1921
Seymour Manufacturing Co., The, 1924
Shawinigan Engineering Co., Ltd., The, 1919
Sheffield Steel Corp., 1921
Shell Chemical Corp., 1928
Shell Oil Co., Inc., New York, N.Y., 1923

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Silver, Bruce Robinson, 1929
Simmons, Raymond S., 1926
Simplex Wire and Cable Co., 1928
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Smith, A. O., Corp., 1919
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Snader, Edward A., 1926
Snoke, Hubert R., 1929
Snyder, E. A., 1925
Snyder, Elmer H., 1926
Société Anonyme John Cockerill, 1925
Société Nationale des Chemins de Fer Belgas Servicio de Documentation, 1926
Socony-Vacuum Oil Co., Inc., 1916
Solan, Cyril J., 1924
Solvay Process Division, The, Allied Chemical and Dye Corp., 1921
Soto, Amador Gonzales, 1926
South Carolina State Highway Dept., 1923
South Dakota State Highway Commission, 1922
South Dakota State School of Mines Library, 1921
Souther Engineering Co., The Henry, 1917
Southern California Edison Co., 1924
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Southwestern Portland Cement Co., 1926
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Staley Manufacturing Co., A. E., 1929
Standard Oil Co., (Indiana), 1925
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Statens Provingsanstalt, 1922
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Stevens Institute of Technology Library, 1924
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Stockham Valves and Fittings, 1928
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Sullivan Mining Co., 1929
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Superior Portland Cement, Inc., 1929
Swan-Finch Oil Corp., 1924
Swarthmore College Engineering Dept., 1922
Swayze, Myron A., 1925
Sydney, University of, Fisher Library, 1920
Symington-Gould Corp., The, 1918
Syracuse University, College of Applied Science, 1926

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Talon, Inc., 1929
Tatnall, Francis G., 1925
Taylor, E. Winthrop, 1917
Taylor Forge and Pipe Works, 1923
Taylor, T. Smith, 1924
Telefonakitiebolaget, L. M., Ericsson, Kavelverket, 1928
Teller, Leslie Wayne, 1924
Templin, Richard L., 1917
Tenney, Ashton M., 1928
Texas, Agricultural and Mechanical College of, Civil Engineering Dept., 1916
Texas, Agricultural and Mechanical College of Engineering, Experiment Station, 1921
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Texas & Pacific Railway Co., The, 1918
Texas Technological College, Department of Civil Engineering, 1928
Texas, University of, Bureau of Engineering Research, 1919
TEXTILE WORLD, 1923
Thomas, Arthur H., Co., 1921
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Tide Water Associated Oil Co., 1927
Torres, Ary Frederico, 1929
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Townsend Co., 1917
Townsend, John R., 1924
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Tulsa, City of, Engineering Dept., 1927
Tyler, W. S., Co., The, 1928

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Udylite Corp., The, 1929
Union Carbide and Carbon Research Laboratories, Inc., 1920
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United States Department of Agriculture Library, 1924
U. S. Industrial Chemicals Co., Division of National Distillers Products Corp., 1925
United States Metals Refining Co., 1915
United States Smelting, Refining and Mining Co., 1917
United States Steel Supply Division, United States Steel Corp., 1916
Universal Atlas Cement Co., 1928
Universal-Cyclops Steel Corp., 1920
Utica, City of, 1927

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Vanadium Corporation of America, 1917
Van Cleef Brothers, Inc., 1923
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Vanderbilt, R. T., Co., Inc., 1919
Vanick, James S., 1918
Vermont State Highway Department, 1925
Victoria, County Roads Board of, 1915
Virginia, Commonwealth of, Department of Highways, 1920
Virginia Military Inst., Civil Engineering Department, 1927
Vogt Machine Co., Henry, 1925
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Wagner Electric Corp., 1927
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Washington, State College of, Library, 1924
Washington, State of, Department of Highways, 1921
Washington Water Power Co., The, 1927
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Wellington Sears Co., Inc., 1919
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Werthan Bag Corp., 1923
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West Coast Lumbermen's Assn., 1919
West Virginia State Road Commission, The, 1920
Westchester County, Department of Public Works, 1926
Westclox Division of General Time Corp., 1924
Western Australia, University of, School of Engineering and Mining, 1921
Western Brass Mills, Division of Olin Industries, Inc., 1920
Western Electric Co., Inc. Kearny Works, 1928
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Wiedemann, H. E., 1924
Wiggin, Thomas H., 1922
Wilhelm, R. M., 1922
Willard Storage Battery Co., 1919
Williams, A. W., 1927
Williams and Co., C. K., 1924
Williams and Co., J. H., 1921
Williams, Guy M., 1919
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Williams, Reginald V., 1923
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Wilson Mechanical Instrument Division, American Chain and Cable Co., Inc., 1928
Wiltsee, William P., 1920
Winnipeg, City of, Engineering Dept., 1922
Wisconsin State Highway Commission, 1925
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Woods, Hubert, 1923
Woodstock Slag Corp., 1927
Woodville Lime Products Co., The, 1920
Woodward, J. Alexander, 1929
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Wool Industries Research Assn., 1929
Work, Lincoln T., 1924
Wyoming Highway Department, 1926

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Yaxley, John W., 1929
Yeager, Frank W., 1920
Young, C. A., 1925
Young, Roderick B., 1916
Young, Roy, N., 1921
Youngstown and Mahoning County, Public Library of, 1921

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The National Bureau of Standards

Activities of the Famous Government Organization Under Review—the Evaluation Committee Report, the Battery Additives Committee Report

The Evaluation Report

RECENTLY the Committee for the Evaluation of the National Bureau of Standards (Mervin J. Kelly, chairman) submitted its recommendations to the Department of Commerce. The committee made a detailed examination of the Bureau's activities, its organization for performing them, its personnel, and its facilities; and from this comprehensive study made its evaluation and recommendations for improvement and strengthening of the Bureau. In submitting the report, Chairman Kelly noted that he had had complete cooperation from the Bureau personnel at all levels. The following are the more significant recommendations made by the Committee in its Summary Report.

1. Higher level of activity in the basic programs.
2. Modernization of facilities and increased space for basic programs.
3. Improvement of organization at the Associate Director level.
4. Transfer of weaponry projects to the Department of Defense.
5. Continued use of the Bureau by Department of Defense and Atomic Energy Commission for non-weaponry science and technical aid.
6. Continued and increased use of the Bureau by other agencies of Government in indicated areas of science and technology.
7. Decrease in repetitive test operations at the Bureau.
8. Division of primary responsibility for policy and procedure on commercial product tests between the Secretary of Commerce and the Director of the Bureau.
9. Increased support of standard samples program.
10. Advisory groups to the Director selected from membership in eight scientific and technical societies.

The paragraphs which follow include some of the Summary Report which is a detailed report of about 100 pages.

Testing and Specifications

In evaluating and commenting on testing and specifications, the committee reported that the testing area of the Bureau's basic programs merited special attention. Quality control, calibration, acceptance, qualification, regulatory and referee testing, standard samples, and product tests are included in this general classification. The funds for this area in fiscal 1953 amount to some $2,600,000.

This field of work might be considered as one of the important end products in the Bureau's basic programs. It is made up of so large a number of specific items that they did not receive individual examination by the committee. The committee recommended that the repetitive test operations of the Bureau be critically examined.

The testing personnel and facilities of the Bureau should be primarily employed in the development of specifications and testing and quality control procedures. The Bureau should exert a leadership for the maintenance of high quality in the products of Government purchase with a minimum of participation in repetitive tests.

Evaluation of Commercial Products

The committee recommended that the policy in establishment of the nontechnical procedures on commercial product tests be the responsibility of the Secretary of Commerce. The policies on the technical content of the problem should reside with the Director of the Bureau. They believed that the commercial product test work involves policies and actions of a nontechnical nature on which the Director of the Bureau should not be required to make the decisions.

Standard Samples

According to the committee, the supplying of standard samples is a proper function for the Bureau and one that within its resources it has performed well. With the restricted funds of recent years and the rising cost of preparing the standard samples, the Bureau has made no progress in increasing the number of kinds of samples. It has actually not been able to maintain its earlier position. Substantially no development for bringing into being new standard samples has been possible for some years. Increased funds for maintenance of present standard sample supply and for the development of new standard samples is urgently needed. The amount charged for the standard samples is small compared to their worth; and this money which goes into the Treasury is not available directly for Bureau use.

Advisory Committee to the Director

Also as part of its evaluation and comments on the Bureau's work, the committee pointed out that the conversion of new scientific knowledge into industrial products is proceeding at an ever-increasing tempo. In forming basic programs of the Bureau, balanced attention should be given to the new areas of science and technology where standards activities will be required. To aid the Director in forming new programs and in considering balance on programs in being, the committee believed that a more intimate tie with the science and technology of the country is desirable. It therefore recommended that the Director form small advisory groups for the different technical and scientific areas of the Bureau.

In making its recommendation for the Advisory Committees to the Director, the committee gave consideration to the Visiting Committee of the Bureau of Standards which is appointed by the Secretary of Commerce by law. The Evaluation Committee saw no conflict between the Secretary's Visiting Committee and the proposed Advisory Committees. In fact, the detailed knowledge of the Bureau's programs that these advisory groups would acqure in performing their duties can be of use to the Secretary's Visiting Committee. The Evaluation Committee recognized that in its studies it has reviewed items that in previous years have received attention from the Secretary's Visiting Committee. In the reports of that committee which came to its attention it found no recommendations inconsistent with those of its own report.

Summary

The committee reached some general conclusions. Besides being of vital importance to national strength, it sees the Bureau as an organization with a splendid record and tradition, internationally recognized and respected In general it is staffed with professional men of competence, integrity, and loyalty to its functions and objectives.

Report of the Committee on Battery Additives—A Summary

The Committee on Battery Additives of the National Academy of Sciences reported on October 30 to Secretary of Commerce Sinclair Weeks that in its opinion there is no merit in the battery additive AD-X2, and that no further tests of it are necessary. The committee completely upheld the competency of the tests conducted by the staff of the National Bureau of Standards.

The Committee

Zay Jeffries, *Chairman,* Vice-President (retired), General Electric Co., Chemical Division
Elmer K. Bolton, Director of Chemical Department (retired), E. I. du Pont de Nemours and Co.
William G. Cochran, Professor of Biostatistics, The Johns Hopkins University
J. P. Fugassi, Professor of Physical Chemistry, Carnegie Institute of Technology
John G. Kirkwood, Professor of Chemistry, Yale Unversity
Victor K. LaMer, Professor of Chemistry, Columbia University
Lewis G. Longworth, Member, Rockefeller Institute for Medical Research
Joseph E. Mayer, Professor of Physical Chemistry, University of Chicago
Fred E. Terman, Dean, School of Engineering, Stanford University
Samuel S. Wilks, Professor of Mathematical Statistics, Princeton University

Summary of Finding on AD-X2

The committee found no data obtained from any well-designed scientific experiment which is inconsistent with the hypothesis that AD-X2 behaves like a corresponding mixture of sodium and magnesium sulfates, and is substantially neutral in its effect upon a lead acid storage battery. These experiments included a total of over 400 cells, a substantial number of which were selected or approved for tests by Pioneers [manufacturers of the additive].

Conclusion on AD-X2

They concluded that the relevant data now available regarding the effects of AD-X2 are adequate to support the position of the National Bureau of Standards that the material is without merit.

They recommended that no additional tests on the merit of AD-X2 be undertaken by the committee or under its supervision since they could not propose new tests which would do more than reinforce the very considerable reliability of the conclusion they have drawn already.

Finding on the Competency of the National Bureau of Standards

To assist in appraising the quality of the work of the Bureau of Standards in the field of lead acid storage battery testing, they obtained brief biographies of scientists and engineers in the Electrochemical Section and in the Statistical Engineering Laboratory. They also obtained biographies of some scientists and engineers in other sections of the Bureau because these engineers and scientists had been called upon for assistance in battery testing. They made a study of the Bureau's work in testing battery additives. They were apprised of the cooperative activities of the Bureau with other laboratories, both in the United States and in other countries. They visited the laboratories of the Electrochemical Section and found them well equipped. They noted the efficient manner in which the Statistical Engineering Laboratory cooperates with the Electrochemical Section, both in the design and in the interpretation of experiments. They have made a special study of the Bureau's work in connection with tests and researches on sodium and magnesium sulfates and on AD-X2.

The MIT Report

It has been said that there is a controversy between the Bureau of Standards and the Massachusetts Institute of Technology. This impression arose, not because there is a controversy of any importance, but because of the interpretation put on the MIT report by a consultant of the Small Business Committee of the United States Senate and the publicity relation to this interpretation. This interpretation was that the "results" in the MIT report "give complete support to the claims of the manufacturer" (of AD-X2).

If certain of the "results" in the MIT report are correct, then there is an inconsistency not only between the MIT report and the Bureau's reports, but also between the MIT report on the one hand and, on the other, the Dean report, the Dirkse report, and the U. S. Testing Co. data.

The committee believed that the source of this inconsistency was in the fact that the MIT tests were not well designed for old batteries differing markedly in the characteristics of the cells. They believe it is possible to deduce from the data in the report that in the majority of the cell pairings it happened that the better cells were treated with AD-X2 and that these same cells, which were initially in better condition, were the ones which showed up to better advantage in the tests. In certain of the cell selections where pretests were made, the treated and untreated cells had somewhat the same characteristics and the results showed no advantage for AD-X2. Had all the cell pairings been selected in this way, they believed the results of Dr. Weber's tests would have been consistent with those of the Bureau of Standards.

By far the most important result in the report is (*a*) which reads as follows:

"(*a*) Among the cells in any chosen battery, all cells in such battery having been subjected to the same previous history, except for treatment with AD-X2, treated cells show larger capacities than did untreated cells, both being subjected to the same conditions of discharge."

The committee believes that if their conclusion is correct that the cell pairings favored AD-X2, the validity of result (*a*) is in doubt. With reference to result (*b*) on sediment, in other tests no difference between treated and untreated cells was observed. There is no disagreement on result (*c*) regarding bubble size. Result (*d*) on plate appearance is not correlated with battery performance. Result (*e*) on loss of liquid would be influenced by cell selection. Result (*f*) on temperature change concerns differences of small magnitudes which do not uniformly favor the treated cells and which may also be influenced by cell selection. Result (*g*) on hydrometer readings, besides not being correlated with battery performance, has not been observed by other testing groups. Result (*h*) is valid for very dilute electrolytes.

The committee is of the opinion, therefore, that the MIT report casts no adverse reflections on the quality of the work of the Bureau of Standards on AD-X2.

Conclusions Regarding the Work of the National Bureau of Standards

The committee from its studies and investigation concluded that the quality of the work of the National Bureau of Standards in the field of lead acid storage battery testing is excellent. This is partly because of the closer cooperation of the Bureau's Statistical Engineering Laboratory with the Electrochemical Section in the design and in the interpretation of battery tests.

United States Resources for the Future

The Mid-Century Conference Makes a Significant Start in Facing a Problem of Fundamental Importance to Our Industrial Economy

HOW CAN we mobilize our resource base—land and its products, water, minerals, and energy—to support the continuously expanding demand of a growing population and contribute to sound economic growth and national security?

It is obvious that this is a question of vast proportions. To begin the job of answering this question, a "Mid-Century Conference on Resources for the Future" was held in Washington, D. C., on December 2, 3, and 4. It was a working conference; it was a citizens' conference for free discussion of the issues, by people concerned with our resources, and was initiated by Resources for Future, Inc., a nonprofit corporation devoted to research and education in the field of resource development and conservation.

A special grant from the Ford Foundation financed the Conference. The objectives of the conference were to survey the natural resources of the nation, explore demands that may be placed upon them during the next twenty-five years, and to investigate methods of use and conservation.

In seeking answers to the many questions that naturally arise in a topic of such breadth, the conference recorded no votes and provided no resolutions; instead *it formally summarized areas of agreement and disagreement*. Its chief purpose was to gather and formally record all current thought on the nation's resources with the idea of making this information available as background material for policy making of private and public agencies.

The conference was organized to work in eight Sections which met concurrently, each section dealing with a single resource area—an aspect of the total picture. Each Section reporter prepared a summary of what developed during his meetings. These were in turn summarized by Section chairman at a final general session.

As background for the sectional groups to use, the Brookings Institute had prepared a paper on the "General Outlook for Resources for the Next 25 Years and Beyond." It discussed trends in population, levels of living, and other factors bearing on production and use of material resources. The paper was used as a point of departure for the opening panel discussion in a general session held December 2. In the paragraphs which follow, what seemed to be most pertinent to ASTM has been taken from the reports of several of the Sections and further summarized.

In describing the opinions and thoughts resulting from these discussions it is unfair to infer that all points of view were adequately represented. Many at the conference, unable to be in two places at one time had to choose among the groups in which they were interested. Because of this, these reports are somewhat the view of only those who were in attendance (and spoke their piece).

Competing Demands for Use of Land

The chairman of the Section, pointed out that urban lands are important not only in their extent but also in the high value they acquire because of the concentration of business activity on them, the investment in them, and the intensive use they are put to by the people who use them. Under the pressure of growth in industrial activity and population, and goaded by the vulnerability to atomic attack that they sense, most of our large cities are undergoing some degree of decentralization. This inevitably brings about conflicting demands for the use of lands. It was generally agreed that commercial airports should be close to cities and that rapid transit between the airport and the city is essential. Obviously military airports should not be near major urban areas.

As a whole, our farm economy was felt to be in excellent condition; there is a good balance among land, labor, and capital. Proper use of capital can improve the production of the some million and a half low production commercial farms which have been spending too much labor with too little capital on poorly productive land.

Competing demands for forest lands differ from region to region. No single pattern of ownership and control is suitable for the North, West, and South. Areas held by the timber processing industry are expanding and it seems economically or politically unwise for this industry to own more than a part of this land. There must be increasing cooperation between the timber-using industry and other forest land owners, private and public. More adequate road systems in the western national forest area received considerable attention. Conflicting interests of large and small operators and the general public must be adjusted to solve this problem.

Construction of water reservoirs often seem to take some of the best farm land out of production. In the future, closer study should be made on over-all results before such projects are started.

The Section suggested four areas for nationwide investigation, they are: (*a*) decentralization of large urban areas, (*b*) congestion in urban centers and competing demands for land for transportation purposes, (*c*) need for increasing our knowledge of wilderness land as we have done for cultivated lands, and (*d*) an appraisal of our land resources, thinking of the needs of future generations.

Use and Development of Land Resources

The chairman of this section reported that for the most part the Section's participants were well agreed on most issues and that their records could serve as guideposts for future policy makers.

Nonwood Fibers.—By 1975 production of food and nonwood fibers should be increased 40 to 50 per cent to fill the forecast need. One way this could be done: increased productivity on land now in use. Basic research offers the greatest long-term promise, coupled with intensified efforts in the use of fertilization, machinery, and new technical aids.

More engineering and technical aid is needed for soil and water conservation. The adequacy of current organization of soil conservation activities was questioned—more research in causes and control of erosion is needed—and ways to replace nutrients at the rate comparable with their removal must be found.

Timber and Wood Products.—The needs for forest products will increase at an accelerated rate in the next 25 years and watershed protection and recreational values likewise will become increasingly important. These latter values must be regarded as a phase of forest development.

There is disagreement on means of reaching these desirable goals although they are steadily being narrowed. However, there are sincere philosophical disagreements which are likely to continue. Research, education, and technical field surveys are the best means for progress in the field of timber and wood products provided *industries*

give greater attention to *applied* research while the *Government* concentrates on *basic* studies—recent trends have been the opposite.

Federal study and private cooperation in fire control should apply to *pest* control as well. There was general approval of a trend to increased state contribution. The landowner should be prepared to assume a reasonable portion of such expenses.

The greatest need for research seemed to be in pest control, watershed management, forest genetics, use of low-quality woods, and economic forest management.

A major increase in public financing support may be needed. There is little sentiment favoring close Federal control of cutting practices but some approval of minimum state control. Primary need for education remains. Accelerated education and assistance programs should improve forest practices in small woodlands to meet future timber requirements. There was varied opinion on proper apportionment of Federal, State, and private responsibility.

The most severe need in order to use fully our forest resources is a good transportation system. Other needs are simpler timber sale procedure, quicker timber inventories, and more advanced timber management, planning, and engineering.

The Section recommended that a Joint Congressional Committee study the pattern of land ownership to determine the need for adjustment—rather than wholesale transfer. This had general support and it was agreed that the basic integrity of structure of the national forest should be maintained.

Water Resources Problems

The chairman noted that some of our ideas of the wise use of water are changing; thus the principle of riparian rights to water in the humid East is being challenged by emerging industrial and agricultural uses. The concept of clean streams is in controversy: there are those who in the national interest would fix the quality status by regulation; others would consider the national interest protected if control is applied only to the extent necessary to satisfy the use required by the communities affected.

It was the opinion of the Section that the Nation's water resources could be so diminished during the next 25 years as to precipitate a series of critical situations—exhaustion of ground water reservoirs, extensive pollution along streams, deterioration of land cover of watershed areas, increased electric power needs, increased farming needs, and increased municipal needs. This does not have to happen. It would be caused by human inadequacy to develop the resource in advance of the crisis need.

Americans will have to learn more about water, evaluate better their needs, and evaluate better the effects of prospective work. In general, it was thought that improvement will be gradual at best: local attitudes, state laws, Federal bureaus, and scientific knowledge of stream flow are slow to change.

Nonfuel Minerals

E. Just, chairman, in opening his summary noted: that to meet the needs of our steadily expanding economy and to bolster the nation's security, domestic mineral exploration and development must be stimulated. It was agreed that new tax modifications for such stimulation are desirable. The preponderant view was in favor of removing the present limitation on the right to treat exploration expenditures as expense items. It was also the view that the three and a half year exemption of income tax should be accorded new mining operations (as in Canada) beginning with the production stage, if it could be shown that such a measure would not present administration difficulties. It was thought unwise to seek special treatment exempting mining capital gains from taxation, although such action would profoundly stimulate investment in new mining ventures.

The Section discussed continued Government financial aid to exploration ventures such as is currently being given under the Defense Minerals Exploration Administration. There was a lack of enthusiasm for this policy with reservations in favor of aid to development of strategic minerals and to small operators. Only in a circumspect manner and only where justification is abundantly clear should Government engage in direct exploration activities.

Energy Resource Problems

Chairman of the Section on Energy Resource Problems, Farrington Daniels, had this to say in summarizing his Section's discussion: "Thankful for the abundant resources of fuel and water power that nature has given us; proud of the achievements of science and technology which have converted these resources into cheap power and made possible our vigorous industrial development and high standard of living; aware of that fact that private enterprise and government have both shared in these developments, and believing that a continuance of this relationship is desirable, we face the future with confidence, realizing we have an abundance of energy resources for far more than the next 25 years, that those types of fuels which become exhausted first can be replaced by other types, that nuclear energy can be brought in when needed, and that still other sources of energy, notably solar energy, lie ahead if we maintain a vigorous program of research."

Problems in Resources Research

In considering a program for the future, it was noted by E. P. Stevenson, chairman, that there has been more ample backing in the past for research in the physical sciences than for the biological sciences, including the science of man and human fertility, consequently we need more fundamental information in the biological field. There is comparatively little correlation of science and technology with the social problems thus created.

Deficiencies in our educational system occupied the attention of the Section for some time. There was some fear that even at this early date we may be too late if we are to give adequate training to the researchers who must provide the answers in resource development a quarter of a century hence.

Analysis has shown that those entering the field of public school education are not the most intelligent. It is common knowledge that the public accords them not merely low esteem and inferior status, but inadequate economic support, hence, is getting what it pays for.

Patterns of Cooperation

This Section reported substantial agreement on several important points. Resource management problems should not be left to the inevitable increase of scientific knowledge and technology. We can never completely centralize our resources planning; it must depend on cooperation among individual groups and governmental agencies. Streamlined agencies are needed to facilitate cooperation with individuals as well as intergovernmental groups. Better integrated programs to meet complex resource situations are needed. Resources scientists can profit by an exchange of knowledge with the social scientists. Cooperation, although an art, is not a magic.

The Section supported (*a*) increased emphasis on resource problems in youth and adults education, (*b*) much research on how to use the behavioral sciences and communications techniques to carry knowledge of the best resources practices to the people, (*c*) the idea that future workers in other areas of the total resources problem should coordinate their work by using the best patterns of cooperation among the individuals and groups concerned.

Materials of Engineering

H. F. Moore and M. B. Moore, McGraw-Hill Book Co., New York, N. Y., 365 pp., $6

A CLASSIC textbook has been revised. The revision is the combined effort of the venerable Dr. Moore, himself, and his son, Mark B. Moore.

In this edition the authors "have tried to meet the problem of discussing the properties of new materials which have become promising since the publication of the 7th edition, without making too long a book."

They have reduced the discussions on properties of materials not closely connected with the resistance of materials. Their list of references has been enlarged.

The last chapter calls the student's attention to the limitations of the ordinary strength formulas and suggests he be alert for results of present-day atomic physicists and metallurgists.

As in previous editions, Dr. Moore has included numerous illustrations, photomicrographs, and fundamental data in the form of curves and tables and again there are his excellent diagrams, important from the teaching angle.

Dr. H. F. Moore is Professor of Engineering Materials, Emeritus, University of Illinois, and has long been a member of ASTM. Dr. Mark B. Moore is Associate Professor of Mechanical Engineering at Rutgers University.

In this edition a chapter on Cohesion, Stress, and Strain was written by Jasper O. Draffin. Harrison F. Gonnerman wrote a chapter on Concrete; Wm. O. Findley wrote one on Plastics.

• • •

Engineering Measurements

R. J. Sweeney, John Wiley & Sons, Inc., New York, N. Y., 261 pp., $5.50

A PRACTICAL, compact treatment of the principles and techniques of measurement for the performance of power equipment is available in this book which is intended as a ready source of information on the common measurement procedure used for such equipment as engines, pumps, compressors, and combustion or heat transfer apparatus. It combines the necessary theory and practical knowledge for students (or practicing engineer) to select and use measuring instruments effectively.

In an introductory chapter the author discusses such topics as Validity of Measurement, Instrument Factors, Installation Errors, Selection of Instruments, and Instrument Control System. In a second chapter on Mensuration, he treats the problems of area as well as linear measurement. Weighing, from the standpoint of mass and density, is covered in a third chapter.

After dealing somewhat comprehensively with electric measurement, dynamometers, and pressure, Mr. Sweeney devotes even greater attention to the various ramifications of temperature measurement. He describes various types of thermometers, pyrometers, time lag, stem conduction, radiation error, and velocity error.

There is an extensive chapter on fluid flow which includes discussions on volumetric flow measurement, obstruction meters, velocity method, orifice meters and rotameters; Venturi tubes, flow nozzles and weirs are covered.

Both fuel and steam calorimeters are discussed. Under a chapter on Chemical Analysis, Mr. Sweeney outlines proximate analysis of coal; there are also paragraphs on the Orsat, gas analysis, and water analysis. He discusses simple on-and-off, floating, and proportional controls; he explains both reset and rate action apparatus such as control valves, valve motors, and relays.

In an appendix, thermoelectric charts have been provided. In this volume the author has compressed much descriptive material, a little mathematics, innumerable precise and well-labeled diagrams, some tabular matter, and a rather complete index.

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Temperature Measurements in Engineering

H. Dean Baker, E. A. Ryder, and N. H. Baker, John Wiley & Sons, Inc., New York, N. Y., 168 pp., $3.75

A FIRST volume, "Temperature Measurements in Engineering," in a two volume program has been finished; its authors have provided what they hope to be a collection of necessary information in nonmathematical form for the engineer who wishes to measure temperature.

They have refrained from including material of infrequent application or of the nature of background theory. They have used the extra space provided to include specific details essential to actual execution. They believe an actual measurement to be a problem in itself, and their approach in the book has been to provide a comprehensive list of possible techniques, methods of analysis, survey of previous designs, and a well-developed procedure of general applicability.

In contrast to previously published books on measurement, stress is placed on specific procedure and techniques involved in producing satisfactory temperature measurement desired for various circumstances. The conditions encountered are classified specifically on a physical basis: interior points in solids, liquids, gases, flames, rather than as the problems of specific industries, each is related to various types of instrumentation.

In this first volume, thermocouple technique is dealt with primarily only because this is the most widely useful method of measuring internal temperatures of solid bodies.

Although many of the chapters are essentially original, free use has been made of manufacturers' literature and of previously published matter. Many references are included to direct the reader to additional useful information. Numerous easy to read curves and diagrams have been included. There are 13 chapters, well indexed.

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Survey, Characteristics, and Evaluation of High-Performance Magnetic Core Materials

Wright Air Development Center, Air Research and Development Command, USAF, 44 pp., Office of Technical Services, U. S. Dept. of Commerce, Washington 25, D. C., $1.50

TO AID in evaluating and comparing magnetic core materials possessing wide frequency and flux density ranges, but differing greatly in other characteristics, a survey was made of several high performance magnetic (or magnelectric) core materials. A few experimental and foreign core materials of excellent characteristics were also included, in addition to the numerous types of standard laminates, powdered materials, and ferrites. The volume explains how they were prepared to compare their characteristics and the methods applied to establish their direct and alternating current qualities.

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Proceedings of the Highway Research Board, 32nd Annual Meeting, 1953

National Academy of Sciences-National Research Council, Washington, D. C., 616 pp.

THE Proceedings of the Thirty-second Annual Meeting (1953) is now available. The two largest sections of the 44 papers should be of interest to ASTM members. These are the sections on Materials and Construction, and Soils. A large proportion of the papers contained in these two sections is written by men who are familiar to ASTM members, and the test methods and apparatus described are of interest to certain of the ASTM Committees.

An Apparatus for Making ASTM-Type Vacuum Distillations

By H. S. Myers[1] and S. T. Kiguchi[1]

SYNOPSIS

For several years, Division VIII on Volatility of ASTM Committee D-2 on Petroleum Products and Lubricants has been conducting a development program on ASTM-type vacuum distillations—Method D 1160-52 T.[2] The use of a vacuum jacket on the distilling column is now under consideration.

The Braun Research Laboratory, which is cooperating in this program, has used a vacuum-jacketed column for about a year. It is inexpensive. It is rugged. And it gives nearly identical results over a wide range of temperatures, pressures, and distillation rates.

This paper describes the column and some of the tests made with it. Studies reported include foam-breaking, the effect of heating the top half of the distilling flask, the effect of distillation rate, and the effect of pressure. In addition, several distillations were made on a pure material to determine the validity of initial boiling points.

Test results lead to these conclusions:

Filling the distilling flask with loose strands of steel wool is an effective method of foam-breaking.

Insulating the top of the distilling flask gives the same results as heating the top of the flask to keep it adiabatic. Superheating of the vapors can occur if the top of the flask is overheated.

Distillation rate and warm-up time are not critical for the vacuum-jacketed apparatus.

A vapor pressure chart based on pure materials can be used to convert vacuum ASTM curves to atmospheric pressure.

Initial boiling points for vacuum ASTM distillations are not significant.

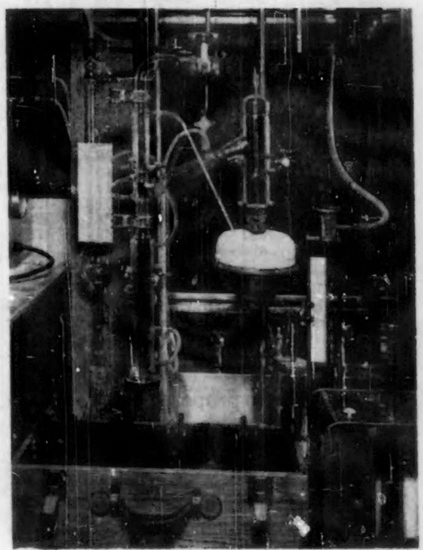

Fig. 1.—Vacuum Distillation Apparatus.

For many years the petroleum industry has used the well known ASTM-type of distillation to characterize relatively low-boiling fractions such as gasolines and kerosines. The apparatus and procedure for such atmospheric pressure distillations are standard throughout the industry. The size and shape of the apparatus, the distillation rate, and the warm-up time are all specified in the ASTM method.

High-boiling stocks, however, such as lubricating oils and reduced crudes, must be distilled under vacuum to prevent cracking. Until 1951, no standard method was available for making an ASTM-type of distillation under vacuum. Each laboratory had its own apparatus and procedure, making it difficult to compare results between laboratories.

For some time, Division VIII on Volatility of ASTM Committee D-2 on

This paper describes a vacuum-jacketed distilling column. The column is inexpensive, rugged, and gives nearly identical test results over a wide range of conditions. It was developed as part of a project by Committee D-2's Division VIII on Volatility to improve the ASTM type-vacuum distillations.

Petroleum Products andLubricants has been working to develop a standard apparatus and procedure for vacuum distillations, and in 1951 a tentative method, D 1160, was published. But the repeatability and the reproducibility of the method are not completely satisfactory. As a result, members of Division VIII are still carrying on extensive development work to improve the test.

A cooperative program is now in progress to study the use of a vacuum-jacketed distilling column instead of the insulated column specified in the tentative method. A vacuum-jacketed column has been used in the Braun Research Laboratory for about a year. This column seems to be entirely satisfactory for making ASTM-type vacuum distillations. It is inexpensive, it is rugged, and it gives nearly identical results over a wide range of temperatures, pressures, and distillation rates.

APPARATUS

Figure 1 shows the complete vacuum-distillation apparatus; Fig. 2 is a sketch of the vacuum-jacketed distilling column, which was made by Glass Engineering Laboratories at Belmont, Calif. It is somewhat similar to the

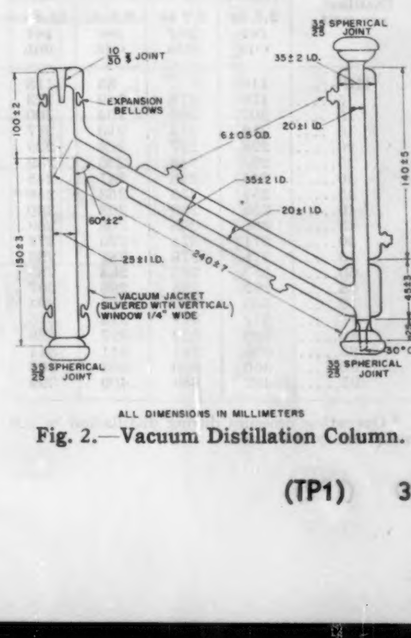

Fig. 2.—Vacuum Distillation Column.

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to ASTM Headquarters, 1916 Race St., Philadelphia 3, Pa.

[1] Research Engineers, C. F. Braun and Co., Alhambra, Calif.

[2] Method of Test for Reduced Pressure Distillation of Petroleum Products (D 1160-52 T), 1952 Book of ASTM Standards, Part 5, p. 584.

TABLE I.—ASTM VACUUM ENGLER DISTILLATION OF SHELL GAS OIL SHOWING EFFECT OF HEAT INPUT TO TOP HALF OF HEATING MANTLE.[a]

Volume Distilled, per cent	Vapor Temperature at 50 mm Mercury, deg Fahr			
	Insulation only	40 watts	60 watts	80 watts
IBP.....	190	177	193	173
5.....	301	299	309	319
10.....	337	338	339	348
15.....	362	361	363	369
20.....	377	377	380	383
25.....	389	389	393	394
30.....	399	399	403	405
35.....	406	407	412	413
40.....	415	415	419	419
45.....	422	422	426	425
50.....	429	428	433	433
55.....	436	435	438	439
60.....	442	442	445	445
65.....	451	448	454	452
70.....	458	457	461	459
75.....	468	467	471	468
80.....	481	480	481	478
85.....	494	494	494	494
90.....	518	518	521	517

[a] Operating pressure during distillation = 50 mm mercury. Distillation rate = 8 to 10 cc per min.

TABLE II.—ASTM VACUUM ENGLER DISTILLATION OF RICHFIELD SAE 10 OIL SHOWING EFFECT OF DISTILLATION RATE.[a]

Volume Distilled, per cent	Vapor Temperature at 50 mm Mercury Absolute, deg Fahr				
	1.8 cc per min	5.2 cc per min	7.1 cc per min	11.2 cc per min	17.3 cc per min
IBP..........	406	448	457	459	462
5..........	499	501	...	501	502
10..........	513	511	514	517	514
15..........	526	526	525	532	533
20..........	539	537	539	540	543
25..........	544	544	549	546	550
30..........	552	553	...	554	559
35..........	562	562	562	562	...
40..........	570	572	572	570	568
45..........	575	580	582	582	...
50..........	587	590	590	590	590
55..........	596	598	601	598	598
60..........	609	609	608	608	609
65..........	618	619	619	616	618
70..........	626	627	627	626	624
75..........	634	639	639	637	634
80..........	647	650	653	649	644
85..........	660	665	667	660	656
90..........	675	679	683	676	672
95..........	675	675	683	688	701

[a] Operating pressure during distillation = 50 mm mercury absolute.

one-piece column proposed by Pan American Refining Corp.

Condensers:

The distilling column has two condenser jackets. The first surrounds the delivery tube that leads from the column to the product receiver. This condenser usually does all or most of the condensing. The second jacket forms a vertical knock-back condenser for lighter materials. For most distillations, hot water is circulated through the lower condenser, and tap water through the vertical condenser.

Thermocouple:

A Kovar-tipped, iron-constantan thermocouple is used to measure vapor temperatures. It differs from the thermocouple specified for Method D 1160 in two ways: a 10/30 Ŧ joint is used instead of a 19/38 Ŧ joint, and the capillary tube is fused directly to the ground-glass joint instead of being sealed with litharge and glycerin. There are several reasons for modifying the ASTM design:

1. The possibility of leakage around the smaller 10/30 Ŧ joint is less than around the 19/38 Ŧ joint.
2. The smaller joint reduces heat loss around the top of the column. This means less condensation and less reflux down the walls.
3. The sealed-in thermocouple avoids the use of litharge and glycerin and thus eliminates a likely source of leaks.
4. The main reason for using the larger joint in the past has been to permit insulation of the thermocouple.

TABLE III.—ASTM VACUUM ENGLER DISTILLATION OF SHELL GAS OIL SHOWING EFFECT OF DISTILLATION RATE.[a]

Volume Distilled, per cent	Vapor Temperature at 1.0 mm Mercury, deg Fahr			
	2.5 cc per min	6.7 cc per min	9.5 cc per min	13.8 cc per min
IBP-....	119	...	85	118
5.....	179	178	169	173
10.....	207	202	194	200
15.....	219	215	210	217
20.....	228	227	226	229
25.....	235	240	236	239
30.....	245	248	247	248
35.....	251	255	253	256
40.....	259	259	263	260
45.....	266	268	268	269
50.....	271	274	275	276
55.....	278	279	281	283
60.....	283	285	288	289
65.....	292	293	295	297
70.....	303	300	304	304
75.....	312	311	314	315
80.....	320	322	327	328
85.....	339	341	341	344
90.....	366	360	368	366
95.....	402	389	409	399

[a] Operating pressure during distillation = 1.0 mm mercury absolute.

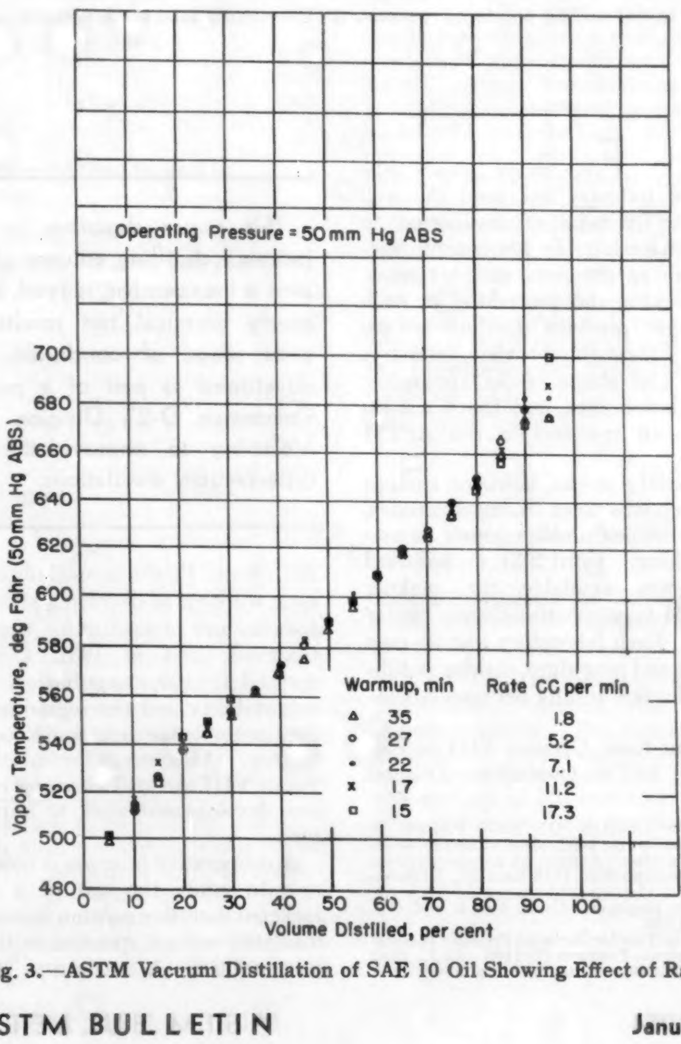

Fig. 3.—ASTM Vacuum Distillation of SAE 10 Oil Showing Effect of Rate.

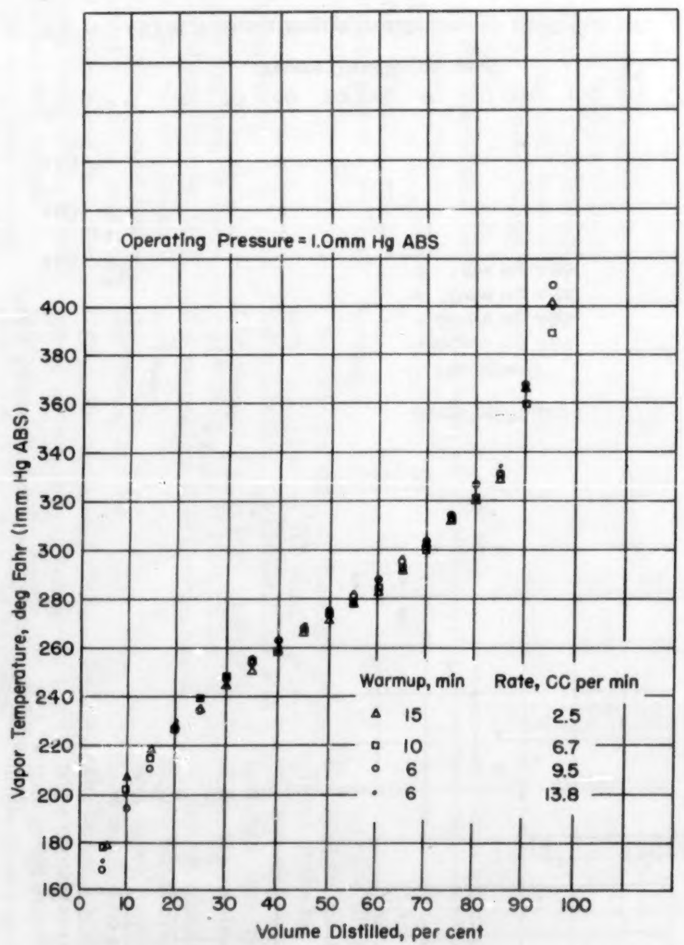

Fig. 4.—ASTM Vacuum Distillation of Shell Gas Oil Showing Effect of Rate.

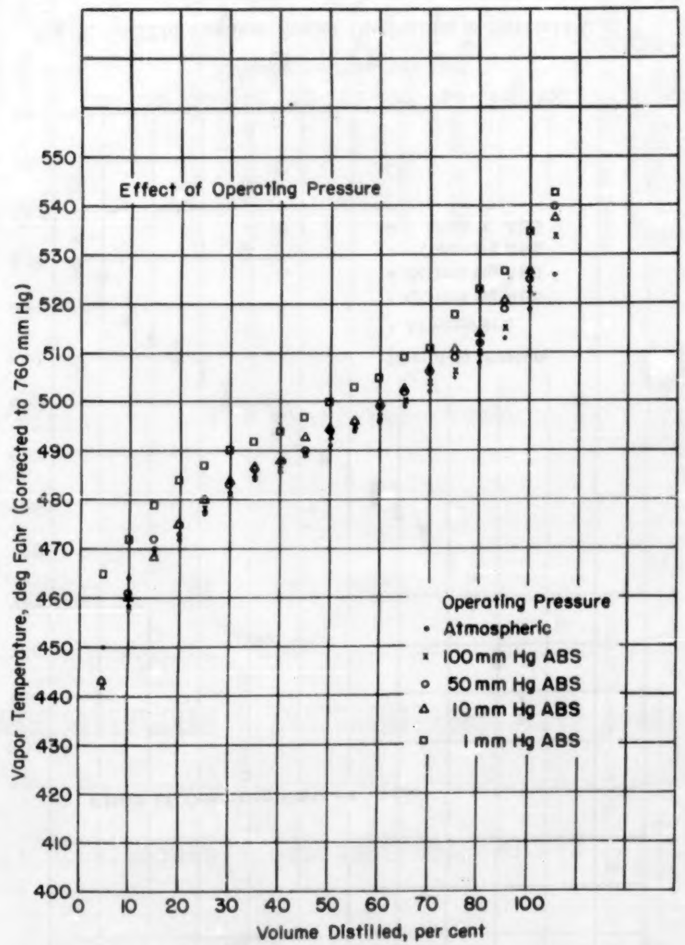

Fig. 5.—ASTM Vacuum Engler Distillation of Standard Absorption Oil No. 2.

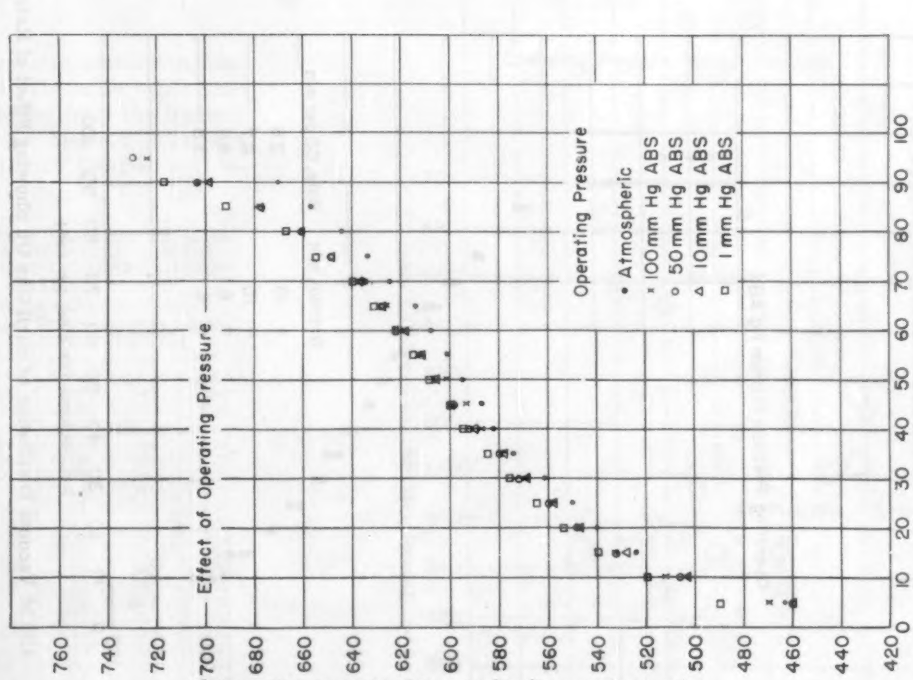

Fig. 6.—ASTM Vacuum Engler Distillation of a Shell Gas Oil.

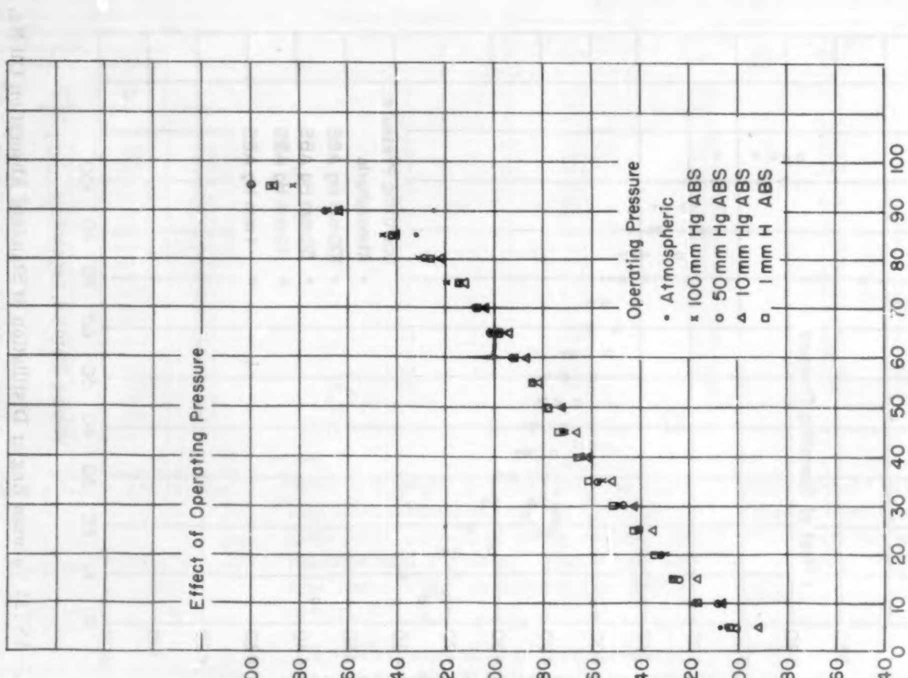

Fig. 7.—ASTM Vacuum Engler Distillation of Sovaloid-C.

Identical results are obtained with an insulated thermocouple and with one fused directly into a ground-glass joint.

5. Recently, one of the members of Division VIII reported difficulty in breaking the 19/38 ₸ joint after a distillation. The 10/30 ₸ joint has never given any such trouble.

Distilling Flask:

The 500-ml flask is made of Vycor[3] and is equipped with a thermometer well and a 35/25 socket joint. Pyrex does not always stand up under the conditions specified by ASTM for this method. On several occasions near the end of a distillation, the bottoms of our Pyrex flasks partially collapsed. Once there was enough distortion to break the thermometer well, and the inrushing air caused the hot oil to burst into flame. The Vycor flasks have been entirely satisfactory.

Pressure Measurement:

Absolute pressures above 20 mm mercury are measured with an absolute-pressure mercury manometer. Below 20 mm, a Dubrovin gage and a McLeod gage are used in parallel. The Dubrovin gage is easier to use during the course of distillation because it is a continuous-reading instrument. The McLeod gage is a little more accurate and is used as a check on the Dubrovin gage at the start of each run. It is protected from condensable vapors by a dry-ice and acetone cold trap.

Pressure Control:

The Micro-Set Manostat made by Precision Scientific Co. is used for vacuum control. It operates on a continuous and an intermittent air leak, both of which are adjustable. It is easy to use, easy to set, and precise.

To smooth out the intermittent operation of the pressure controller, a 5-gal surge tank is used just ahead of the vacuum pump. With this arrangement, fluctuations in pressure are less than 0.1 mm mercury.

Operation

A series of tests was made to determine what factors influence the results of distillations in the vacuum-jacketed column. Included were tests on foam-breaking, the effect of adding heat to the top half of the distilling flask, the effect of distillation rate, and the effect of pressure. In addition, several distillations were run on a pure material to determine the validity of initial boiling points.

[3] Corning Glass Works.

TABLE IV.—ASTM VACUUM ENGLER DISTILLATION OF THREE MATERIALS SHOWING EFFECT OF OPERATING PRESSURE.

Volume Distilled, per cent	Vapor Temperature Corrected to 760 mm Mercury,[a] deg Fahr				
	P = 1 mm Mercury Absolute	P = 10 mm Mercury Absolute	P = 50 mm Mercury Absolute	P = 100 mm Mercury Absolute	Atmospheric Pressure
Standard Absorption Oil No. 2					
IBP	414	370	375	370	338
5	465	443	443	442	450
10	472	460	461	458	464
15	479	468	472	469	470
20	484	475	475	472	473
25	487	480	480	478	477
30	490	484	483	481	481
35	492	487	486	485	484
40	494	488	488	486	486
45	497	493	490	489	489
50	500	495	494	493	491
55	503	496	496	495	494
60	505	500	499	497	496
65	509	503	502	500	499
70	511	507	506	504	502
75	518	511	509	506	505
80	523	514	512	510	508
85	527	521	519	515	513
90	535	527	525	523	519
95	543	538	540	534	526
Shell Gas Oil					
IBP	435	350	340	335	173
5	490	460	460	470	463
10	520	503	506	512	503
15	540	528	531	533	524
20	554	547	549	547	540
25	565	558	560	558	550
30	576	569	572	570	561
35	585	578	580	578	574
40	595	590	592	587	582
45	600	600	598	593	587
50	609	606	306	601	595
55	615	612	612	612	601
60	622	618	621	619	608
65	631	627	623	626	614
70	640	637	635	635	624
75	655	649	649	...	633
80	667	661	661	...	644
85	692	679	678	677	657
90	717	699	704	703	670
95	759	742	730	724	653
Sovaloid-C					
IBP	554	563	549	577	504
5	604	592	601	605	608
10	617	607	609	618	619
15	627	617	624	627	626
20	635	629	632	630	632
25	643	635	641	641	640
30	652	643	647	649	649
35	662	651	658	656	657
40	666	661	664	663	667
45	674	666	672	671	671
50	679	672	678	678	678
55	685	681	685	685	684
60	691	687	693	692	691
65	698	695	702	699	701
70	707	704	707	708	709
75	714	711	715	720	714
80	726	721	729	731	723
85	741	740	742	746	732
90	764	764	770	769	725
95	792	790	800	783	...

[a] Corrected by vapor pressure chart of Myers and Fenske (see footnote 4).

Foaming:

Several methods of foam-breaking were tried. One of the most effective methods is to fill the distilling flask with loose strands of steel wool, as suggested in ASTM Method D 1160. This practice was used for all of the runs reported in this paper.

Top Heating Mantle:

Glass-Col Apparatus Co. supplies a special quartz heating mantle for this method. The mantle covers only the bottom half of the flask. An additional mantle was used on the top of the flask to study whether there was any advantage in keeping the flask adiabatic.

A series of distillations was made on the same gas oil, with varying amounts of heat to the top mantle, and a similar run was made with the top of the flask insulated but not heated. Table I shows the results.

There is a definite tendency for the boiling points to increase with increasing heat input, particularly at the higher heat inputs and at the fore part of the distillation. Apparently, the vapors are being superheated and the efficient vacuum jacket does not permit these vapors to lose their superheat before they reach the thermocouple.

The data shown in Table I for 40-w input should be the ideal values, since a

dry flask calibration showed that 40 w were required to keep the flask adiabatic. With insulation alone, the data agree almost exactly with those from the 40-w run. This indicates that insulating the flask is all that is necessary and, in addition, does not risk superheating the vapors.

For this foamglass insulation is very satisfactory. It can easily be carved to fit the flask and is readily removable.

Effect of Rate:

ASTM Method D 1160 specifies a distillation rate of 4 to 8 ml per min. Figure 3 and the corresponding Table II show the results of rate studies on an SAE 10 oil at an absolute pressure of 50 mm mercury. Rates varied from 1.8 to 17.3 ml per min, and warm-up times from 15 to 35 min. Except for the initial boiling point and the 95 per cent point, the data show close agreement. The greatest deviation is 8 F, which is within the expected accuracy for the method.

Figure 4 and Table III show similar studies on a gas oil at 1 mm mercury absolute pressure. Again the distillation rate has not affected the results. Apparently, distillation rate and warm-up time are not critical for the vacuum-jacketed apparatus.

Effect of Pressure:

A series of distillations was made at 1 mm, 10 mm, 50 mm, 100 mm, and atmospheric pressure, on three different stocks—an absorption oil, a gas oil, and a fused aromatic material called Sovaloid-C. Figures 5, 6, and 7 and Table IV show the results of correcting all of the vacuum data to atmospheric pressure. This was done by means of a vapor pressure chart developed by Myers and Fenske.[4] This chart is based on experimental data for pure materials and narrow boiling cuts. It has been submitted to *Industrial and Engineering Chemistry* for publication, and should appear very shortly. The results indicate that for high boiling materials pressure has little effect on the shape of the distillation curve.

Vacuum curves can also be corrected to atmospheric pressure with good accuracy using a vapor pressure chart based on pure materials. The curves corrected from 10 mm and higher show average deviations of about 8 to 10 deg from the true atmospheric curve, and those from 1 mm, about 10 to 15 deg. This accuracy is just about the same as that of the Myers and Fenske chart.

[4] H. S. Myers, thesis for Ph.D. degree, The Pennsylvania State University, State College, Pa. (1952).

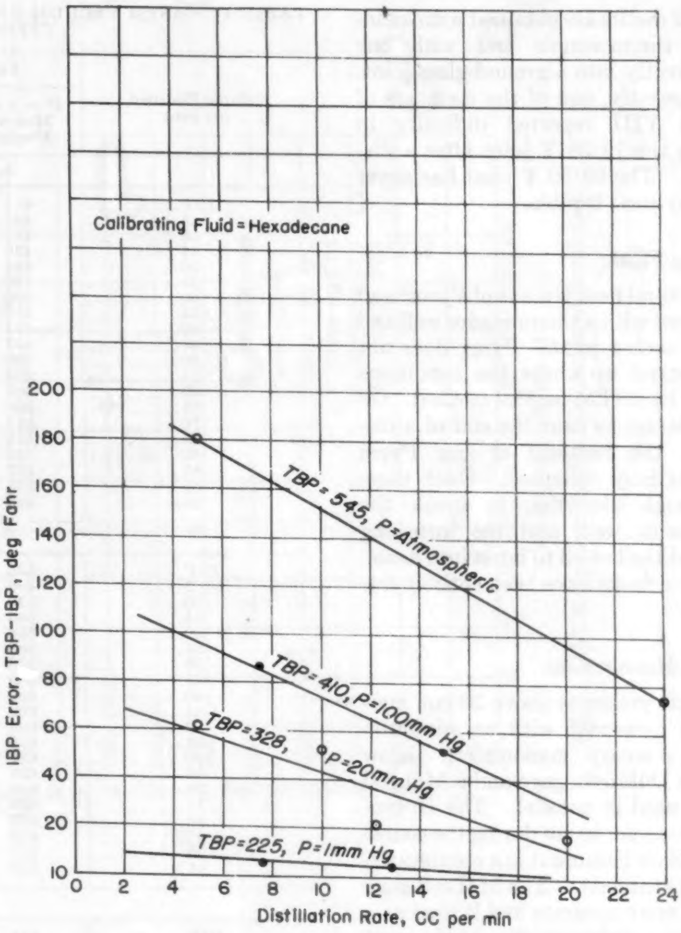

Fig. 8.—Error in IBP Measurements at Various Operating Temperatures and Distillation Rates.

Initial Boiling Point Studies:

There has been much discussion concerning the validity of initial boiling points (IBP). It seemed that a good way to approach this problem would be to perform an ASTM distillation on an essentially pure material. Then any deviation between the initial boiling point and the true boiling point of the material being distilled would be an inherent error in the method.

A series of ASTM distillations was made on hexadecane that had previously been fractionated in a 60-plate column. The effect of distillation rate and of temperature level were both studied. The temperature level was varied by operating at different pressures.

Figure 8 shows the results of these studies. The amount of IBP error due to time lag is directly proportional to temperature level and inversely proportional to distillation rate. Furthermore, the magnitudes of the errors are very large, approaching 200 F for materials boiling at about 550 F at low rates. By the time 5 per cent of the charge had been distilled, however, there was no longer any error for the conditions studied.

It was suggested that a bare wire thermocouple, because of its low heat capacity, might reduce the IBP error. But tests made with a bare thermocouple gave results almost identical with those obtained with the Kovar couple.

These studies with a pure material indicate that the initial boiling point of a vacuum Engler distillation has no significance.

Temperature Measurements in the Mooney Viscometer*

By George E. Decker[1] and Robert D. Stiehler[1]

Synopsis

Temperatures measured by means of thermocouples inserted through the plungers according to the design originally described by Taylor, *et al.* (2)[2] and specified in ASTM Method D 1077 - 49 T[3] were found to be intermediate between those of the rubber in the die cavity and those of the upper die. These temperatures were sensitive to changes in the temperature of the upper die and were virtually independent of the temperature of the lower die.

An investigation of insulating materials (such as hard rubber) for supporting the thermocouple in the die cavity indicated that, although the thermal conductivity of these materials is much smaller than that of the plunger supporting the thermocouple adopted by ASTM, it is still too large for reliable measurement of the rubber temperature. In addition, these materials were found to be too fragile for this purpose.

A study was also made of the temperature differentials existing in the dies and die cavity both in the presence and absence of rubber. The study included the regular two-piece die and die holder and the integral die and die holder proposed by Decker and Roth (3). The results indicate that the integral unit transferred heat much more rapidly but reflected more of the temperature gradients in the platens.

The most practical method for assuring reproducible temperature conditions in different viscometers is to measure and control the temperature of the dies, preferably using the integral units proposed by Decker and Roth.

The authors find that the thermal conductivity of the insulating materials (such as hard rubber) used for supporting the thermocouple in the die cavity of the Mooney Viscometer is small, but still too large for reliable measurement of the rubber temperature. Also these materials may be too fragile for this purpose.

The authors' study also includes results on temperature differentials, of the dies and die cavity, existing in the presence or absence of rubber. Results indicate that the "integral unit" transfers heat more rapidly but reflects more of the gradients in the platens than the "regular unit" does.

The measurement of Mooney viscosity and the determination of the vulcanization characteristics of rubber compounds by means of the Mooney viscometer require reliable measurement and control of temperature. The objective is to have a means of assuring that the temperature of the rubber in the die cavity shall be within ±½ F from one test to another whether the tests are made with the same viscometer or with different viscometers. Temperature measurements are made most commonly with mercury-glass thermometers in wells provided in the platens. Temperatures measured in this way often differ from the temperatures in the dies and die cavity by several degrees—a difference that is not the same for different viscometers.

In order to measure the temperature of the rubber specimen directly and thus eliminate variations between different viscometers, Taylor and Ball (1) recommend the method originally described by Taylor, Fielding, and Mooney (2). This method, incorporated in ASTM Method D 1077 - 49 T,[3] uses thermocouples inserted through steel plungers into the die cavity. The plungers are drilled axially, and the end of the hole is lined with a thin tube of some nonconducting material intended to insulate the thermocouple from the metal plunger shell both thermally and electrically.

This arrangement, which was in use at the National Bureau of Standards for about three years prior to 1950, has several shortcomings. The conduction of heat along the steel plunger shell and through the insulating tube is sufficiently great for the temperature of the thermocouple junction to be nearer to that of the plunger, which is about the same as that of the upper die and platen, than to that of the rubber. The tube in the plunger does not reduce the heat transfer significantly since it has been found that the thermocouple junction may be soldered to the end of the steel plunger without causing any appreciable effect on the observed temperatures. The life of these thermocouples is short since no effective means has been found for rigidly fastening them to the insulating tube and the plunger.

A more reliable means of measuring the temperature is needed. This paper gives the results of an investigation on this subject.

It is important to emphasize at the outset that it is extremely difficult to make reliable measurements of temperature in an instrument like the Mooney viscometer. Because of dimensional limitations, a thermocouple or thermistor is the only practical temperature-sensing element to use. However, the temperature of a thermocouple or a thermistor is likely to be different from that of the rubber to be measured unless precautions are taken to prevent appreciable heat transfer to or from the tensing element along the lead wires or supporting device. The lack of this safeguard is the principal deficiency of the method incorporated in ASTM Method D 1077. Further, no practical means are evident for overcoming this deficiency. Even if the sensing element and leads could be so insulated that the element is at the same temperature as that of the rubber in contact with it, there would still be a need for some means of assuring that the upper and lower dies are at the same temperature. ASTM Method D 1077 recommends the use of the mercury-glass thermometers in the platens in an attempt to achieve this end. Since the temperatures indicated by these thermometers may differ from those of the dies

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* This work was performed as part of the research project sponsored by the Reconstruction Finance Corp., Office of Synthetic Rubber, in connection with the Government Synthetic Rubber Program.

[1] Technologist, Rubber Section, and Chief, Testing and Specifications Section, respectively, National Bureau of Standards, Washington, D. C.

[2] The boldface numbers in parentheses refer to the list of references appended to this paper.

[3] Tentative Method of Test for Curing Characteristics of Vulcanizable Mixtures During Heating by the Shearing Disk Viscometer (D 1077 - 49 T), 1952 Book of ASTM Standards, Part 6, p. 483.

by several degrees, and since there is no suitable method for measuring the temperature of the rubber in routine tests, another solution is needed. The most feasible one appears to be the measurement and control of the temperature of the dies instead of the temperature of the rubber in the die cavity. Under steady-state conditions these temperatures are practically identical so that the substitution is a legitimate one. If the die and die holder are replaced by an integral unit described by Decker and Roth (3), the temperature of the rubber becomes essentially equal to that of the dies in about 7 min after the platens are closed.

Procedure

Temperatures were measured in this study by means of copper-constantan thermocouples. Several arrangements were used to make temperature measurements in the die cavity. Two of these arrangements are shown in Fig. 1. Plunger No. 1 is the design given in ASTM Method D 1077 (hereinafter referred to as the ASTM thermocouple). Plunger No. 2 contains no metal other than the lead wires for the thermocouple and does not extend into the platen. Variations in this second design included two lengths of plunger (one extending from the upper die approximately one half of the depth of the die cavity and the other three fourths of the depth) and plungers made from different materials including a polybutadiene resin, nylon, melamine-bonded glass fiber, and several special hard rubbers having high softening temperatures.

In a third arrangement, a coil of thermocouple wire was placed in the die cavity with the thermocouple junction close to one of the plungers, and the lead wires were brought outside through the other plunger hole without making thermal contact with the die, platen, or other material. A fourth arrangement was a differential thermocouple, one junction of which is fastened to the die and the other junction freely suspended in the die cavity. Special dies were used which had four $\frac{1}{16}$-in. holes drilled into the working faces for fastening the thermocouple junction. The holes were located 90 deg apart about $\frac{1}{8}$ in. from the edge at the front, sides, and back. In making differential temperature measurements, the suspended junction was placed midway between the dies directly between corresponding holes in the upper and lower dies. Measurements were made of the difference between the air temperature in each of the four positions and the die temperature in each quadrant, making 32 measurements in a set.

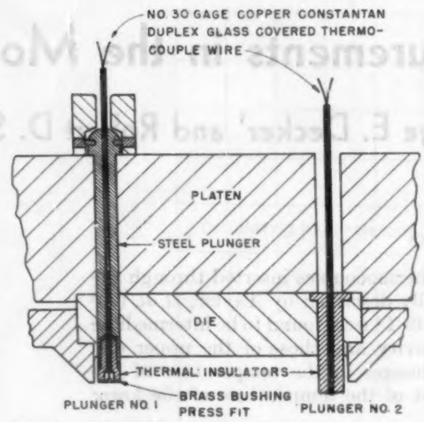

Fig. 1.—Two Thermocouple Arrangements for Measuring Temperatures in the Die Cavity of the Mooney Viscometer.

Finally, in a fifth arrangement, a differential couple was used having one junction mounted on a hard rubber post and held at a point in the rubber specimen midway between the upper and lower dies and halfway between the outer circumference of the rotor and the outer wall of the cavity. The hard rubber post was fixed to the lower die in the left quadrant. The other junction was fastened in a small hole in the front quadrant of the lower die, and the wire connecting the junctions was laid in the corner of the outer circumference around the back of the cavity. The leads were brought out through a small hole in the die holder.

In the first experiments with plunger No. 1, No. 20-gage duplex copper-constantan wire having glass insulation was used. It was found that under steady-state conditions the temperature of the thermocouple junction was appreciably below that of the dies and the cavity, presumably because of thermal conduction along the lead wires. In order to eliminate any possibility of erroneously low temperatures from this cause, the No. 20-gage thermocouple wire was replaced with No. 30-gage duplex copper-constantan wire (also glass insulated) and the leads were lagged to the platen for a distance of about 12 in. This No. 30-gage wire

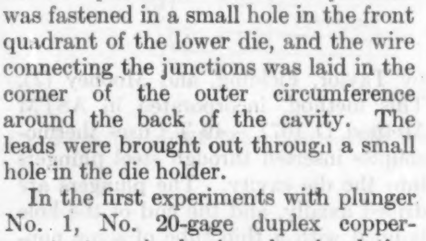

Fig. 2.—Location of Thermocouple Wells in Lower Dies.

and lagging of the leads was employed for all temperature measurements reported in this paper.

Except in the fourth arrangement noted above, the temperature of the dies was measured by means of copper-constantan thermocouples inserted into $\frac{1}{8}$-in. holes and fastened to the dies as shown in Fig. 2. The thermocouple junction is silver soldered to a copper plug which is held in thermal contact with the die by means of an Allen head set screw. In the direct measurement of temperature variations within the dies, four thermocouples spaced 90 deg apart were used. The method of attachment of thermocouples to the upper die was similar to that shown for the lower die in Fig. 2.

Most of the thermal potentials of the thermocouples were measured by means of a precision portable potentiometer (Leeds & Northrup No. 8662). Some of the measurements were made by means of a strip-chart temperature recorder (Brown Electronik Model Y153X11P-X-(IV)) having graduations every Fahrenheit degree. Both instruments were calibrated by means of a benzoic acid cell (4). A rotary switch was used to connect each thermocouple in turn to the measuring instrument.

Tests were made at temperatures near 212 F (100 C) and 293 F (145 C), which are the two temperatures specified in the Specifications for Government Synthetic Rubbers[4] for making measurements with the Mooney viscometer.

Results and Discussion

A comparison of the temperatures of the rubber in the die cavity measured by means of a thermocouple of the design given in Fig. 1 and plunger No. 1 (arrangement 1) and those measured with a coiled thermocouple in the rubber specimen (arrangement 3) with the junction near the plunger is shown in Fig. 3. The zero point in the time scale is the instant that the die cavity is closed. In this type of experiment it is not possible to start and run the motor because of the coiled thermocouple in the specimen. It is seen that the plunger thermocouple is at a higher temperature than the coiled thermocouple near it in the rubber specimen until the steady-state condition is reached approximately 10 min after the die cavity is closed. The higher temperature of the plunger thermocouple is apparently caused by heat conducted by the plunger from the upper die and platen.

[4] Specifications for Government Synthetic Rubbers, revised edition, Reconstruction Finance Corp., Office of Synthetic Rubber, Washington, D. C. (1952).

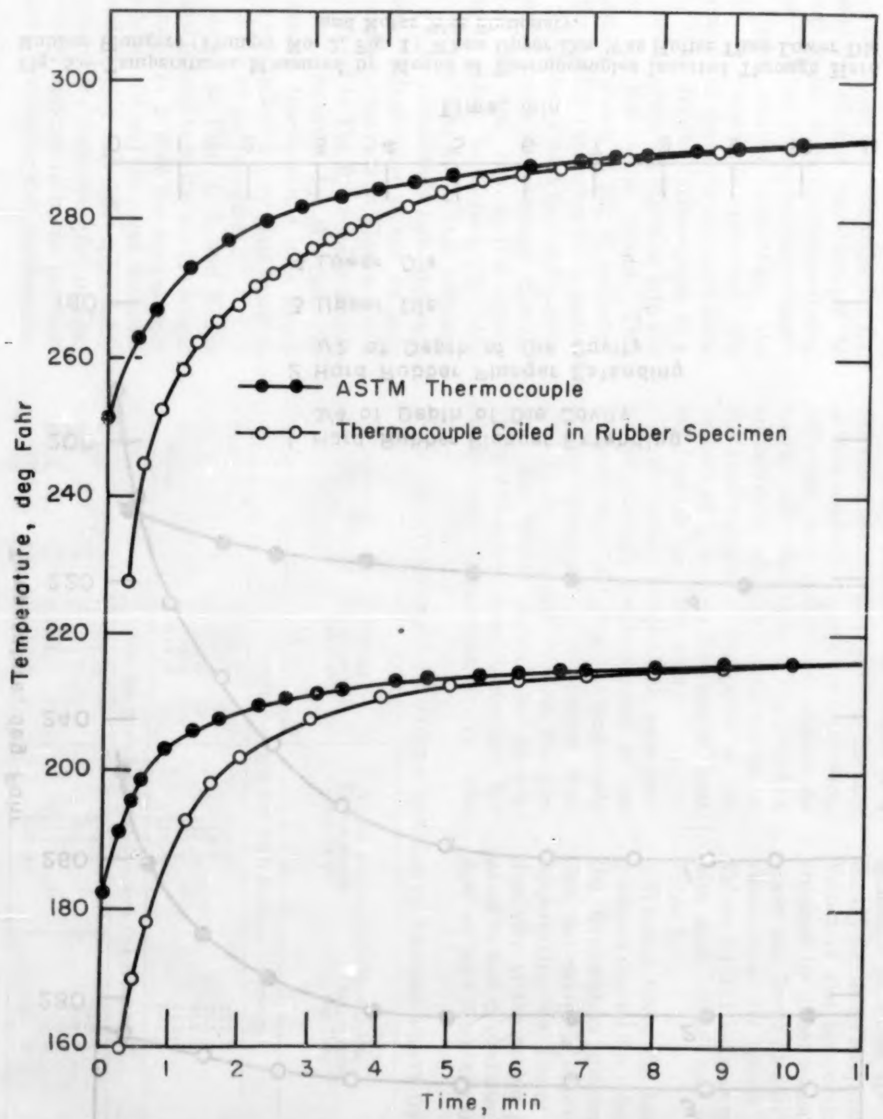

Fig. 3.—Temperatures in the Die Cavity Obtained with Two Thermocouple Arrangements While the Rotor Was Stationary. The temperature of the dies for the upper curves was 293 F and for the lower curves 216 F.

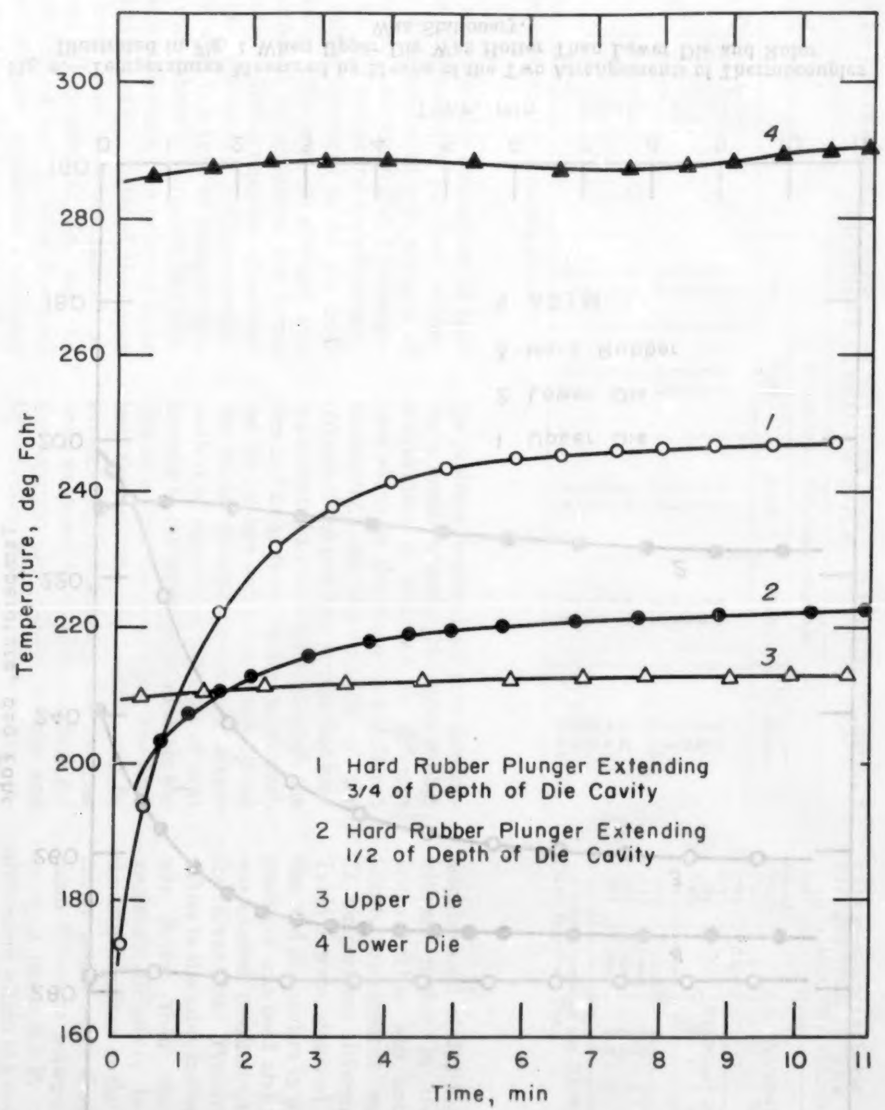

Fig. 4.—Temperatures Measured by Means of Thermocouples Inserted Through Hard Rubber Plungers (Plunger No. 2, Fig. 1) When Lower Die Was Hotter Than Upper Die and Rotor Was Stationary.

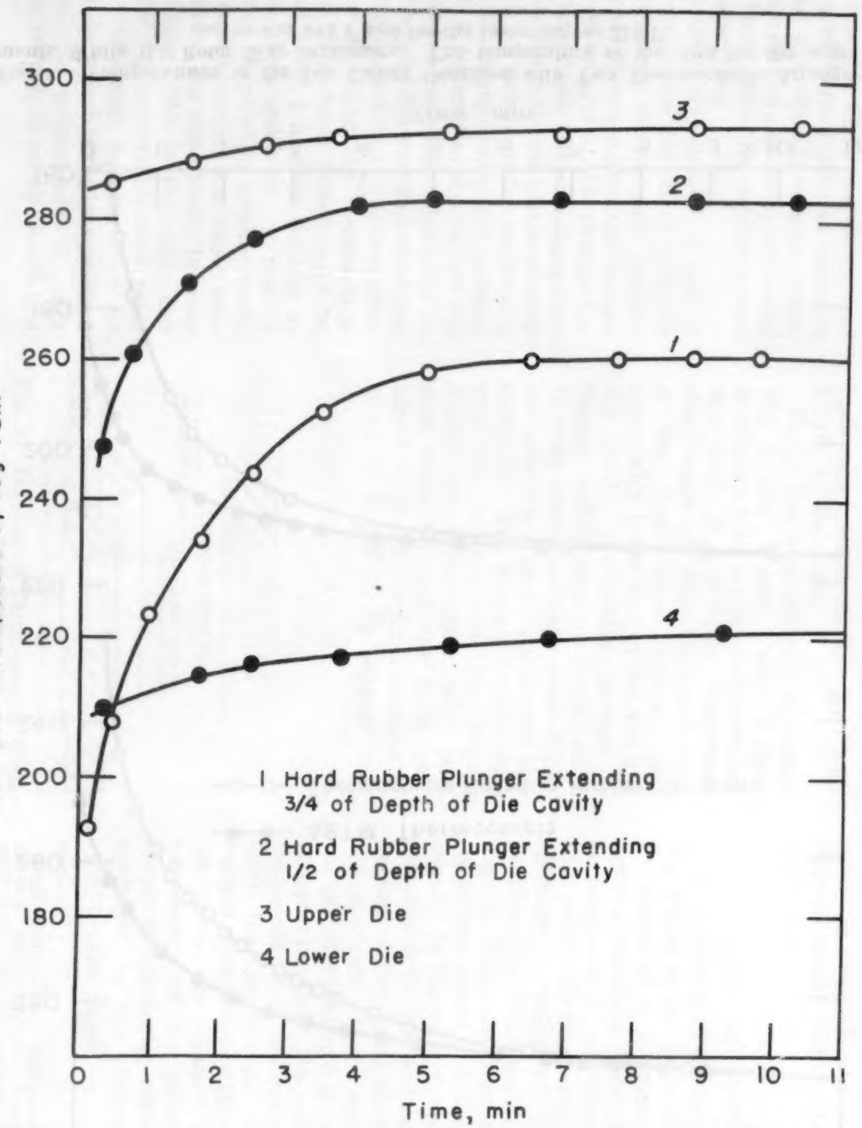

Fig. 5.—Temperatures Measured by Means of Thermocouples Inserted Through Hard Rubber Plungers (Plunger No. 2, Fig. 1) When Upper Die Was Hotter Than Lower Die and Rotor Was Stationary.

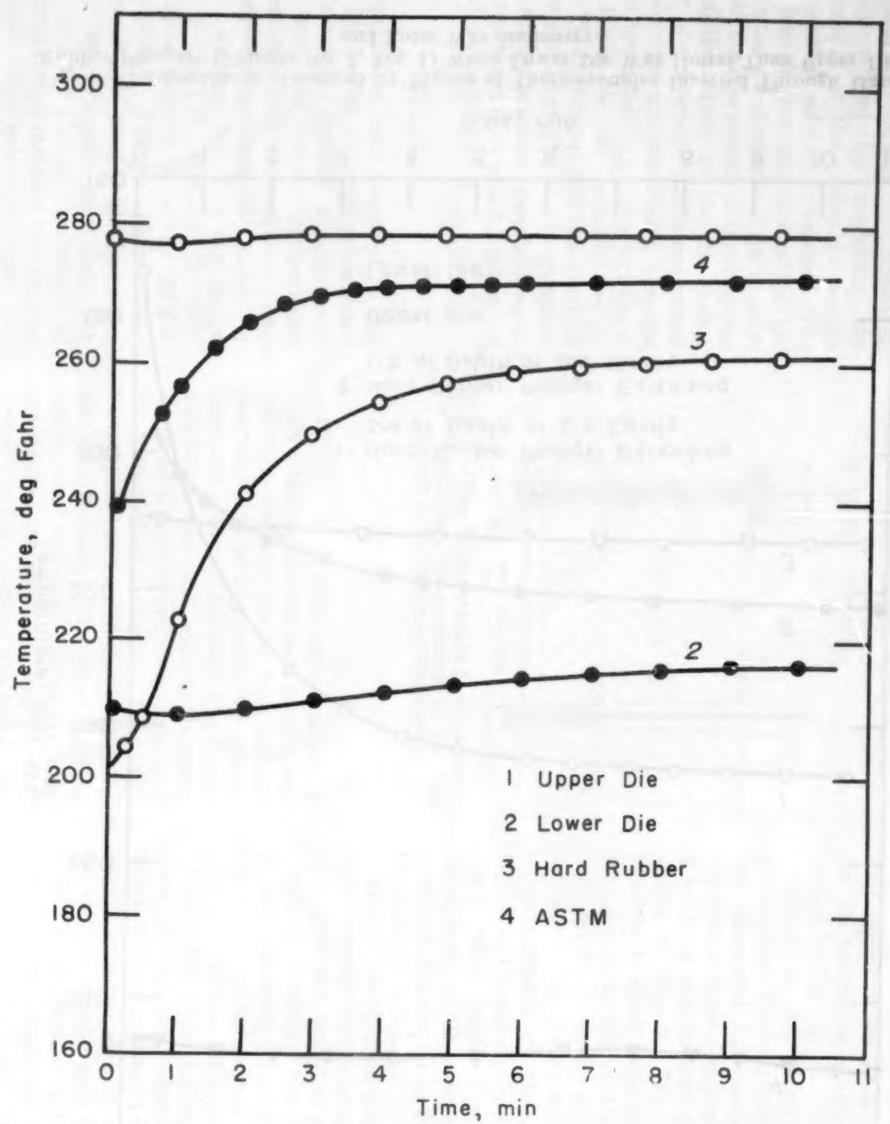

Fig. 6.—Temperatures Measured by Means of the Two Arrangements of Thermocouples Illustrated in Fig. 1 When Upper Die Was Hotter Than Lower Die and Rotor Was Stationary.

TABLE I.—TEMPERATURE DIFFERENCES BETWEEN DIES AND DIE CAVITY USING A DIFFERENTIAL THERMOCOUPLE.

Position in Die Cavity	Temperature Difference, deg Fahr: Front	Left	Back	Right	Mean
Position in dies:[a]					
Upper front	0.9	0.8	0.7	0.5	0.7
Upper left	0.1	0.5	0.5	0.4	0.4
Upper back	0.3	0.2	0.3	0.3	0.3
Upper right	0.6	0.5	0.4	0.3	0.4
Mean	0.5	0.5	0.5	0.4	0.45
Lower front	0.7	0.9	1.0	0.8	0.8
Lower left	0.3	0.4	0.5	0.4	0.4
Lower back	0.4	0.6	0.7	0.4	0.5
Lower right	0.8	1.0	1.0	0.8	0.9
Mean	0.5	0.7	0.8	0.6	0.65

[a] Die temperature was approximately 212 F.

TABLE II.—MAXIMUM TEMPERATURE DIFFERENCES IN THE DIES OF THE MOONEY VISCOMETER.

Steady State Temperature, deg Fahr	Die	Temperature Difference, deg Fahr: Machine No. 1	Machine No. 2[a]	Machine No. 3[a]
212	Upper	0.4	0.4	0.4
212	Lower	0.8	0.7	0.6
293	Upper	0.8	...	0.4
293	Lower	1.7	...	1.4

[a] Viscometers at the GR-S Synthetic Rubber Plant, Baytown, Tex.

To minimize this conduction of heat to the thermocouple junction, experiments were conducted with plungers of design No. 2 shown in Fig. 1 (arrangement 2). Of the several materials used, hard rubber appeared to be the most promising. However, its strength was not sufficient to withstand the forces encountered during repeated operations of the viscometer. Consequently, studies with this type of plunger were made with rubber in the cavity but with the rotor stationary. In order to make a critical test of this material, the upper and lower dies were maintained at different temperatures. As can be seen in Figs. 4 and 5, even the hard rubber plunger conducted sufficient heat so that the temperature of a thermocouple junction placed midway between the dies was much closer to that of the upper die. In order for the temperature of the thermocouple to reflect the mean of the die temperatures, the junction had to be close to the lower die. Under similar conditions, the ASTM thermocouple reflected the temperature of the upper die much more closely than did the thermocouple in a hard rubber plunger projecting into the rubber to the same extent. This comparison, shown in Fig. 6, indicated that the ASTM thermocouple is such a good conductor of heat that it has little advantage over a thermocouple directly in the dies and has several disadvantages noted heretofore. In this study, it was also noted that different hard rubber compounds have different thermal conductivities as can be seen by comparing curve 2 in Figs. 4 and 5 with curve 3 in Fig. 6. Similar results have been reported by Whorlow (5) who used a thermocouple in a hypodermic needle isolated by glass beads in place of one of the plungers.

As shown in Figs. 4, 5, and 6, the principal objection to the use of plunger thermocouples is that the temperature of the lower die and the mean temperature of the rubber may differ appreciably from that of the thermocouple junction. Since there appears to be no practical means for overcoming this shortcoming, the problem resolves itself into developing a means whereby the same rubber temperature is obtained in different tests either in the same or a different viscometer. An examination of the physics of the problem reveals that heat is conducted to the rubber through the dies and away from the rubber through the die holders and rotor except during the initial heating period. A simple method of controlling the rate of heat transfer to the rubber is to maintain the dies at a fixed temperature. The heat lost through the die holders can be avoided by substituting the integral units suggested by Decker and Roth for the separate dies and die holders and by shielding the viscometer from excessive air currents in the room. Then, the only variable that could cause variations in the rubber temperature is a difference among viscometers in the rate of heat conduction along the rotor stem. Although such differences cannot be readily controlled, they can be held to a minimum by adequate specifications on the construction of the parts of the viscometer governing the rate of heat lost through the rotor stem.

If the rubber temperature were controlled through measurements of the temperature of the dies, the magnitude of any temperature differences that exist in the dies and between the dies and the rubber should be known. These differences were determined for steady-state temperatures in the neighborhood of 212 F both with and without rubber in the die cavity. When rubber was not present, the fourth arrangement was used. The 32 temperature differentials given in Table I were observed with standard dies and die holders in which no rubber grommet was used and the rotor stem was in close proximity to the metal of the lower die. Positive temperature values in the table indicate that the die was hotter than the cavity. The maximum difference between any of the four positions in the die and in the cavity is not more than 1 F and the mean difference between the dies and cavity is about 0.5 F. The maximum differences within the cavity and within the dies are about 0.2 and 0.5 F, respectively. Further, the left front quadrant of either die is at approximately the mean temperature of the die. Values of the temperature differences obtained by direct measurement in the upper and lower dies in three Mooney viscometers are given in Table II. Values for 212 F agree reasonably well with each other and with those in Table I.

When a lower die having a rubber grommet around the rotor shaft is used, the temperature differential between dies and cavity is approximately 2 F. Apparently, the poorer thermal conductivity of the rubber grommet compared to that of steel results in a greater flow of heat from the cavity through

TABLE III.—TEMPERATURE OF THE RUBBER IN VARIOUS PARTS OF THE CAVITY.

Position of Thermocouple in Cavity	Rubber Temperature, deg Fahr	Upper Die Temperature, deg Fahr	Lower Die Temperature, deg Fahr	Temperature Difference Between Rubber and Dies, deg Fahr
Commercial Die Set with Rubber Grommet				
Front	210.7	211.7	211.8	1.05
Left	210.8	211.9	211.9	1.10
Back	210.6	211.7	211.8	1.15
Right	210.9	211.8	211.8	0.90
Mean	210.8	211.8	211.8	1.05
Die Set with Integral Die and Die Holders				
Front	212.0	212.5	212.5	0.50
Left	211.7	212.6	212.7	0.95
Back	211.5	212.5	212.5	1.00
Right	212.1	212.7	212.7	0.60
Mean	211.8	212.6	212.6	0.76

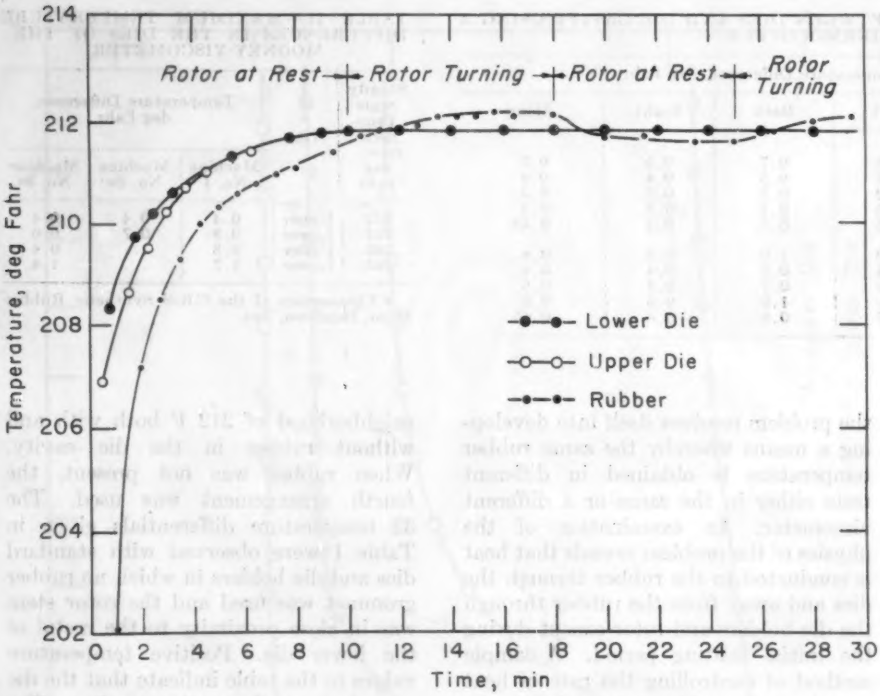

Fig. 7.—Effect on Rubber Temperature Caused by Turning the Rotor at 2 rpm.

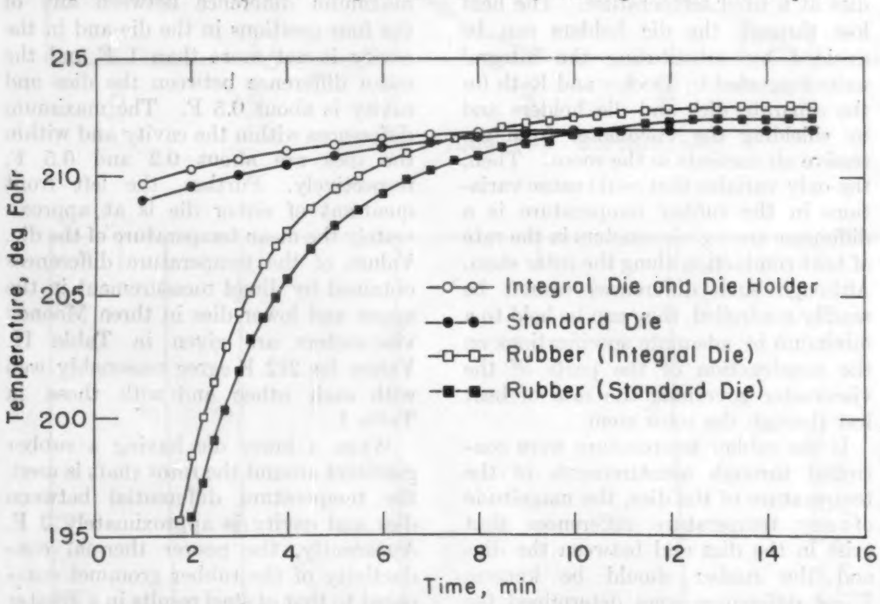

Fig. 8.—Temperatures of Rubber and Dies Obtained During Regular Tests at 212 F Showing the Greater Rate of Heat Transfer of the Integral Die and Die Holder.

the rotor stem. Measurement of the temperature of the rotor confirms this conclusion since it was about 1.5 F lower when a die with a rubber grommet was used, even when rubber was in the cavity.

When rubber was present in the die cavity, the temperature differences were determined by the third arrangement described under Procedure. The junction was placed successively at each of the four positions previously mentioned. Measurements were made using both the standard two-piece die and die holder and the integral die and die holder proposed by Decker and Roth. The lower die in each case had a rubber grommet. A thermocouple fastened to the left front quadrant as shown in Fig. 2 was used to measure the die temperature. The data given in Table III indicated that the temperature differential between dies and rubber was slightly over 1 F when standard dies were used and about 0.8 F when the integral dies and die holders were used. On the other hand, the temperature differences within the rubber were about 0.25 and 0.5 F for the standard and integral dies, respectively. These results indicate that the integral dies have the advantage of more rapid heat transfer but reflect more of the temperature gradients in the viscometer platens. Also, a comparison of Tables I and III indicates that the presence of rubber reduces the temperature differential between dies and cavity to approximately one half.

The results reported thus far were obtained with the rotor stationary. In order to determine the effect on the temperature of the rubber when the rotor was turning, the fifth arrangement described under Procedure was used. Using integral dies and die holders with a rubber grommet in the lower one, the results shown in Fig. 7 were obtained with Y-108 GR-I synthetic rubber which has a Mooney viscosity of about 46. Shearing of the rubber in the die cavity caused the temperature to rise approximately 0.5 F and to exceed slightly the temperature of the dies. In other words, the energy of shearing more than compensated for the heat lost through the rotor stem. Whorlow (5) also found an increase in the temperature of the rubber caused by the energy introduced through shearing, but his conditions were much more severe than those in this study.

Finally, a comparison was made of the temperature of the rubber during a normal test using the standard and the integral dies mentioned heretofore. Tests were made at both 212 and 293 F. Two different samples of GR-I were used; the one had a viscosity of about 50 at 212 F and the other about the same value at 293 F. Thus, the energy input was approximately the same at each temperature. The results shown in Figs. 8 and 9 were obtained. At 212 F, the temperature of the rubber exceeded that of the dies for both types of dies. However, the temperature curves crossed at about 8 min when integral dies were used and at about 11 min when standard dies were used. At 293 F, the temperature curves crossed when integral dies were used at about 10 min, whereas the temperature curves obtained with the standard dies did not cross in 18 min; in fact, the rubber temperature was still about one degree below that of the dies. Further, the temperature of the integral dies did not decrease so much as that of the standard dies at the start of the test. These results confirmed the previous observations regarding the more rapid heat transfer of the integral dies.

Conclusions

These results indicate that there are always temperature gradients in the dies or die cavity of the Mooney

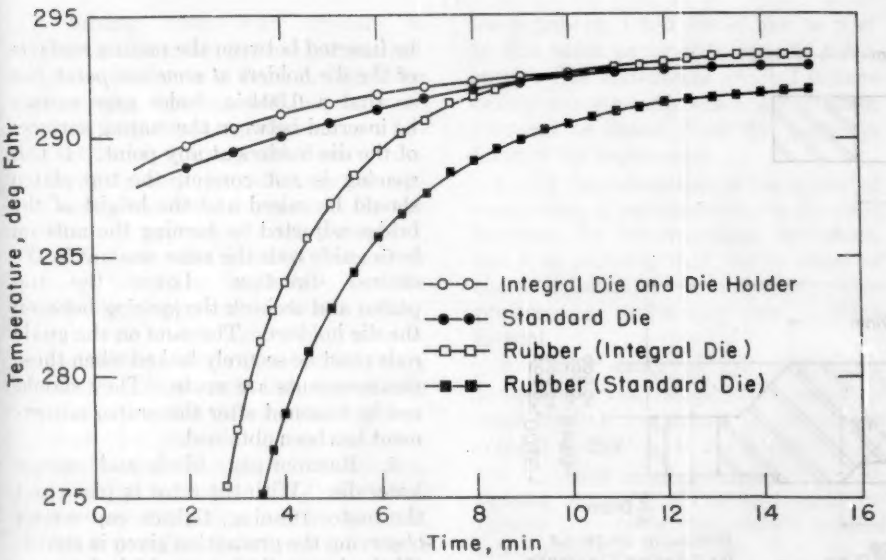

Fig. 9.—Temperatures of Rubber and Dies Obtained During Tests at 293 F. The pronounced effect on rubber temperature caused by the greater rate of heat transfer of the integral die and die holder is shown.

viscometer. Further, there appears to be no practical means for measuring the rubber temperature during the test. In this situation, it is possible only to establish a procedure that will result in reproducible temperatures both in repeated tests with the same viscometer and with different viscometers. The most practical solution appears to be the measurement and control of the temperature of the upper and lower dies. For this purpose, the integral dies proposed by Decker and Roth are preferred because of their superior heat transfer characteristics and the greater ease of using thermocouples with them.

In any case, the type of die to be used should be standardized, and such constructional features as the presence or absence of a rubber grommet in the lower die should be specified.

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Note on the Adjustment of Mooney Viscometer Die Closure*

By George E. Decker[1]

During the past 10 yr, considerable progress has been made in standardizing the Mooney viscometer and in improving the reproducibility of measurements from one instrument to another. The method for adjusting the viscometer die closure developed by Taylor[2] was a major contribution in this respect. In this procedure the die closure adjustment is obtained by setting a specified distance between the mating surfaces of the die holders with feeler gages and then turning the top guide rod nuts down $\frac{1}{12}$ turn to obtain the desired pressure between the die holders. The chief disadvantages of this procedure are: (1) the $\frac{1}{12}$ turn of the guide rod nuts must be estimated by the operator, (2) the guide rods move sideways in the holes in the bridge when the nuts are loosened, and (3) the threads on the guide rods are not uniform. A modified procedure providing a more accurate and reproducible adjustment is described.

This procedure uses a special cylindrical gage block (*a* in Fig. 1) to replace the lower die during the operation of setting the distance between the mating surfaces of the die holders. Since the gage block is 0.008 in. thinner than the lower die at the shoulder, adjustment of the die closure by this method will produce a total deformation of 0.004 to 0.006 in. in the various members of the linkage, as recommended by Taylor.[2] When this method of die closure is used in connection with the integral die and die holders, which are described elsewhere,[3] the integral gage block illustrated at *b* in Fig. 1 is used.

Use of this procedure at the National Bureau of Standards and in the government synthetic rubber plants during the past $2\frac{1}{2}$ yr has resulted in considerable improvement in the accuracy and reproducibility in die closure adjustments.

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[1] Technologist, Rubber Section, National Bureau of Standards, Washington, D. C.

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[3] G. E. Decker and F. L. Roth, "Influence of Variations in Rotors, Dies, and Rate of Shear on Mooney Viscosity," *India Rubber World*, Vol. 128, p. 339 (1953).

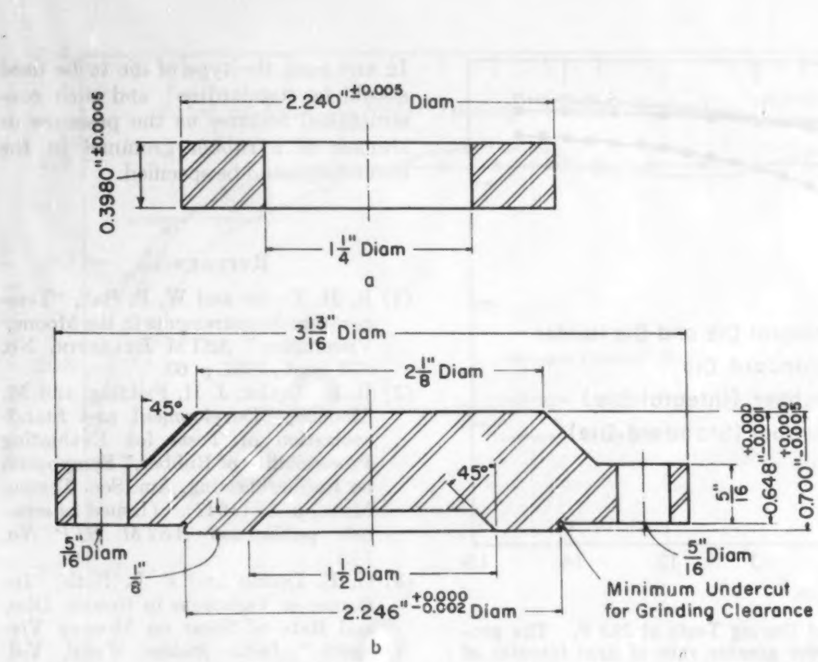

Fig. 1.—Gage Blocks for Use in Adjusting Mooney Viscometer Die Closure.

(a) For use with two-piece die and die holder. *(b)* For use with integral die and die holder.

Adjustment of Die Closure

The improved procedure is as follows:

1. Make sure that the dies and die holders are clean and properly installed and the temperature of the viscometer is at 212 F. Adjust the bridge so that it is parallel with the top platen and align the linkage so that all the pins are on a common centerline when the viscometer is closed.

2. Remove the lower die and replace it with one of the gage blocks shown in Fig. 1. Care should be exercised in tightening the cap screws in order that the die holder is not deformed by having one screw tighter than another or by having all the screws too tight.

3. Place four coil springs between the platens, one at each corner. These springs should have a free length of $2\frac{1}{2}$ in., a minimum deflection of $1\frac{1}{4}$ in., a spring constant of about 130 lb per in., and have flat and ground ends. Suitable springs having a $\frac{3}{8}$-in. pitch can be made by winding $\frac{1}{8}$-in. spring wire on a 0.66-in. diameter mandrel.

4. Lower the top platen with the springs in place and measure the distance between the mating surfaces of the die holders. This distance should be such that a 0.002-in. feeler gage can be inserted between the mating surfaces of the die holders *at some one point*, but so that a 0.004-in. feeler gage cannot be inserted between the mating surfaces of the die holders at any point. If this spacing is not correct, the top platen should be raised and the height of the bridge adjusted by turning the nuts on both guide rods the same amount in the desired direction. Lower the top platen and recheck the spacing between the die holders. The nuts on the guide rods must be securely locked when these measurements are made. They should not be loosened after the proper adjustment has been obtained.

5. Remove gage block and replace lower die. With the rotor in place and the motor running, tighten cap screws observing the precaution given in step 2. (If the lower die is one which does not have the rubber washer, and the fluctuation of the dial gage is increased when the cap screws are tightened, the die should be shifted to a position at which the periodic fluctuations are not increased when the cap screws are tightened.)

6. Make a pattern of the die closure by closing the machine after placing a piece of thin (not thicker than 0.0015 in.) soft tissue paper between the dies. If a continuous pattern of uniform intensity is not obtained, one of the following items may be at fault: (1) die holder may be cocked or deformed due to uneven tightness of the screws, (2) lip of die holder may be worn, or (3) one or more of the dies or die holders may not meet the specified dimensional tolerances.

7. If it is necessary to change the position of either die holder or to replace any of the parts in order to obtain a desired die pattern, the die closure should be readjusted.

Discussion of Paper on Setting of Gypsum Plaster[1]

Mr. W. C. Hansen.[2]—Mr. Fischer concludes that the initial setting of plaster of Paris occurs before gypsum is formed and that materials which retard the rate of setting encase the hemihydrate particles in such a way as to prevent sorption of water and the formation of a gel. Also, he indicates that there is a "colloidal mechanism" involved that does not involve the crystallization of gypsum.

In the days when Le Chatelier and Michaelis were at odds over their colloidal *versus* crystallization theories, the concept of colloidal materials differed from that of today. Investigators today are attempting to determine the crystal structure of the colloidal cement gel. Bernal, Jeffery, and Taylor,[3] after reviewing information on the crystal structure of hydrated calcium silicates, make the following statement: "This gives added weight to the idea that the bonding material in set cement, at any rate when formed at room temperature, consists of ill-formed, and probably bent and tangled, crystals."

A paper[4] was published in 1930, in which it was shown that some salts that retard the rate of setting of plaster of Paris retard the rate at which gypsum crystallizes from supersaturated solutions. It was also shown that the rates at which plaster of Paris - water pastes release heat are accelerated by seeding

[1] H. C. Fischer, "The Setting of Gypsum Plaster," ASTM Bulletin, No. 192, September, 1953, p. 43 (TP 133).

[2] Manager, Research Laboratories, Universal Atlas Cement Co., Gary, Ind.

[3] J. D. Bernal, J. W. Jeffery, and H. F. W. Taylor, "Crystallographic Research on the Hydration of Portland Cement," *Magazine of Concrete Research*, Vol. 11, p. 47 (1952).

[4] W. C. Hansen, "Hydration of Calcined Gypsum," *Industrial and Engineering Chemistry*, Am. Chemical Soc., Vol. 22, p. 611 (1930).

the mixing water with crystals of gypsum. It seemed from this work that in pastes of plaster of Paris in which the plaster did not contain a retarder, gypsum began to crystallize almost immediately after the plaster was mixed with water and that the rate of precipitation increased for a time as the number of gypsum crystals increased. On this basis, the initial stiffening or setting could be explained by the formation of gypsum crystals.

It is well known that certain properties of crystal, such as solubility, vary to some extent with the size of the crystal. It seems that the starting temperature for the endotherm, in differential thermal analysis, for the reaction $CaSO_4.2H_20 = CaSO_4.O.5H_2O + 1.5H_2O$ could vary with the size of the crystals. If this is possible, endotherm B in Fig. 5 might be the result of this reaction instead of the desorption of adsorbed water as postulated by Mr. Fischer. It would be interesting to know if any effort was made to identify gypsum in these samples by microscopic and X-ray methods. There is also a question as to whether or not the shape of endotherm A in Fig. 4 might not be caused by a considerable quantity of very fine crystals in the sample.

MR. H. C. FISCHER (*author's closure*).—Mr. Hansen's comments indicate that, in his opinion, the setting of plaster is a mechanism of simple solution followed by simple precipitation of gypsum crystals. He is by no means alone with respect to this belief inasmuch as the proponents of the crystallization theory follow this line of reasoning. However correct or incorrect the crystallization or colloidal theories may be, in any case the mechanism can hardly be described as simple.

Mr. Hansen's reference to the bonding material in set portland cement pastes[2] is a bit puzzling unless one chooses to take an unqualified belief in a mere analogy as being applicable to a specific problem. If the bonding material in set cement is of a crystalline nature (and I use the word *if*), what direct bearing has this on the dissimilar $CaSO_4 - H_2O$ system?

Inasmuch as Mr. Hansen chose the paper of Bernal, *et al.*[3] to strengthen his argument, I too would like to refer to this same paper with specific reference to five statements which I believe nullify any strength which Mr. Hansen feels can be drawn from that paper in favor of his arguments:

1. "Direct detection of the hydrated compounds in set cement has so far been hindered by experimental difficulties, but it is probable that one or other of these substances is present." This professes a probability but nothing factual.

2. "The study of the compounds formed at room temperature, which is more directly important in relation to cement chemistry, is made difficult by the fact that they are gelatinous, ill-defined systems." The statement indicates that the system, under normal environmental conditions, not as in hydrothermal synthesis, may be of a colloidal nature.

3. "A direct attack on this problem by X-ray investigation of laboratory preparations of these compounds has so far met with very limited success, since even in the hydrothermal preparations the crystals are too small for individual study." This further emphasizes the uncertainty.

4. "It seems not unlikely that, while the chemical reactions taking place when water acts on the cement compounds in a paste are the same as those occurring in a dilute suspension, the degree of crystallization of the product is even poorer and may be very low indeed. This gives added weight to the idea that the bonding material in set cement, at any rate when formed at room temperature consists of ill-formed, and probably bent and tangled crystals." Mr. Hansen quoted the last part only, yet the first part points to a poor and very low degree of crystallinity perhaps amorphous or colloidal.

It has not been my intention to criticize the work of Bernal, *et al.*, inasmuch as I feel that they have given a good review of the set cement problem. However, I do criticize Mr. Hansen for attempting to apply such results of conjecture and uncertainty on the cement-water system to the plaster problem.

With reference to Mr. Hansen's query as to the possibility of endotherm B in Fig. 5 being a result of fine-sized gypsum rather than adsorbed water, I would like to point out several facts:

1. The size of an endothermic area is a direct function of the weight of material undergoing thermal decomposition.

2. As the weight of gypsum increases, so does the endothermic area representing the thermal decomposition to hemihydrate.

3. Endotherm B (Fig. 5) at 30 min is much smaller than at 10 min.

Now if, as Mr. Hansen suggests, endotherm B is due to gypsum, a considerable amount of gypsum must have vanished over the period between 10 and 30 min. This is, of course, an impossible situation. The increase of adsorbed water between 3 and 10 min (Fig. 5), followed by a decrease between 10 and 30 min is not difficult to understand; in the former period physical adsorption is occurring, whereas in the latter period physical adsorption gives way to chemosorption with the ensuing chemical hydration of the hemihydrate.

As to the shape of endotherm A in Fig. 4 being a result of, to quote Mr. Hansen, "a considerable quantity of very fine crystals in the sample," I must say that there is nothing whatsoever unusual about the shape of this curve and consequently I fail to see any reason for Mr. Hansen's supposition as to the crystalline size of the material.

Microscopic and X-ray methods were not employed in my experimental work. Differential thermal analysis was used because it has shown its merits in a previous study of white coat plaster.[5]

Those who prefer to favor the mechanism of initial set as being one of gypsum crystallization have yet to explain satisfactorily the occurrence of a definite and measurable yield point in the paste prior to the evolution of heat, the latter being due to the chemical hydration of the hemihydrate to form gypsum. The final set or hardening at a later age is undoubtedly due to a felting together and interlocking of gypsum crystals.

Mr. Hansen's comments are well received and I appreciate the interest shown in this very old problem.

[5] J. A. Murray and H. C. Fischer, "A Study of White Coat Plaster by Differential Thermal Analysis," *Proceedings*, Am. Soc. Testing Mats., Vol. 51, p. 1197 (1951).

The Effect of Temperature on the Air Aging of Rubber Vulcanizates

By A. E. Juve[1] and M. G. Schoch, Jr.[2]

How does exposure temperature affect the deterioration of elastomer vulcanizates? In this paper the authors have provided new data as part of a continuing program to answer this question. The data on the effects of room temperature aging supplement data presented in a previous paper on other aging temperatures.

The data show that for most of the synthetic elastomers the mechanism of deterioration is essentially the same over the temperature range of room temperature to 150 C, the rate depending on the temperature in a regular way. Natural rubber compositions behave similarly except over a narrower temperature range. Limitations on the upper end of the temperature range are discussed. To extrapolate accelerated aging test data to room temperature requires a knowledge of the temperature dependence of the deterioration for the particular material being considered.

In a previous paper of the same title (**6**)[3] data were reported on two series of tests designed to determine the effects of the aging temperature on the deterioration of a series of vulcanizates prepared from several rubbers. Since the time of that report additional data have been accumulated for the room temperature aging periods for both series of tests. For most of the stocks the deterioration at room temperature has now proceeded sufficiently so that it is possible to compare the progress of deterioration at all the test temperatures. Several additional periods of room temperature aging are to be run, but the first of these is several years in the future. The purpose of this report is to present the additional data and to attempt to answer, so far as the data permit, the question which prompted the initiation of the two test programs. This was, how does the temperature of exposure affect the deterioration of several typical elastomer compounds?

Data and Discussion:

The formulations employed in the two test programs are given in Tables I and II. The aging periods selected and the test data for the previous tests will be found in the earlier report (**6**). The original and aged data for the room temperature tests for both series of tests are given in Tables III and IV.

To show more clearly the effect of temperature on the deterioration of stress-strain properties, the data in Tables III and IV and the data from the previous paper for the higher temperatures are plotted as percentages of the original property (modulus, tensile strength, and elongation) *versus* time on a logarithmic scale. These plots are shown in Figs. 1 to 15, inclusive. Two sets of curves are shown in these illustrations (except for Figs. 7 and 8). The aging data with which we

TABLE I.—COMPOUNDS USED FOR TEST A.

	No. 1	No. 2	No. 3	No. 4	No. 5
Smoked sheets	...	100.00	...	...	...
Hycar OR-15	...	...	...	...	100.00
Neoprene GN-A	...	...	100.00	...	...
GR-S	100.00	...	...	...	...
GR-I—Y-15	...	...	...	100.00	...
Zinc oxide	5.00	5.00	5.00	5.00	5.00
Stearic acid	1.00	3.00	1.00	1.00	1.00
Age Rite powder	...	0.50	...	...	...
Age Rite HP	...	1.00	...	...	...
Sulfur	1.60	3.00	...	2.00	1.50
Mercapto benzo thiazole	1.55	0.80	...	0.50	...
Benzo thiazyl disulfide	...	...	...	...	1.50
EPC black	...	...	35.00	25.00	...
SRF black	...	...	...	25.00	75.00
MPC black	50.00	50.00	...	...	...
Pine tar	...	4.00	...	...	...
Paraflux	6.00	...	...	...	...
Plasticizer SC	...	...	...	...	15.00
Diphenyl guanidine	0.65	...	...	...	...
Neozone A	...	...	2.00	...	...
Ex. lt. calc. MgO	...	...	4.00	...	...
ASTM oil No. 3	...	...	5.00	...	...
TMTD[a]	...	...	...	1.00	...
Fthyl tellurac	...	...	...	1.00	...
Tributoxy ethyl phosphate	...	...	...	...	15.00
Paraffin	...	...	...	1.00	...
Curing times, min	35 60 90 180	20 45 90 135	15 45 90 135	10 20 30 60	15 45 90 135
Curing temperature, deg Fahr	275	275	290	300	275

[a] Tetramethylthiuramdisulfide.

TABLE II.—COMPOUNDS USED FOR TEST B.

	No. 1	No. 2	No. 3	No. 4	No. 5
Smoked sheets	100	...	100	100	...
Hycar OR-15	...	50	...	...	...
Perbunan 26	...	50	...	...	...
GR-S	...	...	...	...	100
Zinc oxide	5	5	5	5	5
Stearic acid	1	0.5	1.5	...	...
AgeRite resin D	5	5	...	...	...
AgeRite powder	...	...	1	...	...
Sulfur	...	...	3	3.5	2.0
Mercapto benzo thiazole	...	1.5	0.9	...	...
Acc. 808	...	...	...	1.0	...
Santocure	...	...	...	...	1.2
TMTD[a]	3	3	...	...	...
EPC black	...	...	50	50	50
FT black	75	...	...	...	...
SRF black	...	70	...	...	...
Pine tar	...	...	5	5	...
Paraflux	...	...	...	...	5
Plasticizer SC	...	15	...	...	...
Curing times, min	25	25	30	45	45
Curing temperature, deg Fahr	307	307	292	292	292

[a] Tetramethylthiuramdisulfide.

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to ASTM Headquarters, 1916 Race St., Philadelphia 3, Pa.

[1] The B. F. Goodrich Research Center, Brecksville, Ohio.

[2] Hewitt Rubber Division, Hewitt-Robins, Inc., Buffalo, N. Y.

[3] The boldface numbers in parentheses refer to the list of references appended to the paper.

TABLE III.—RESULTS OF TEST A.

Aging Time	Compound No. 1[a]			Compound No. 2[b]			Compound No. 3[c]			Compound No. 4[d]			Compound No. 5[e]		
	200 per cent			300 per cent			300 per cent			300 per cent			300 per cent		
	Modulus	Tensile Strength	Elongation	Modulus	Tensile Strength	Elongation	Modulus	Tensile Strength	Elongation	Modulus	Tensile Strength	Elongation	Modulus	Tensile Strength	Elongation
Original	461	2150	550	1457	4070	615	1950	3700	500	835	1760	540	1547	2450	510
	588	2315	500	1740	3990	560	2142	3675	470	1073	1710	440	1745	2500	465
1 year U S[f]	616	2249	532	1821	4120	584	2128	3633	476	850	1670	507	1618	2516	435
	782	2644	526	2155	3876	503	2270	3666	446	1090	1615	440	1816	2487	450
2 year U S	680	2230	475	1970	3809	526	2260	3315	440	830	1660	530	1753	2343	446
	843	2188	375	2200	3538	455	2307	3420	425	1075	1600	445	1943	2450	417
3 year U S	941	2190	450	1992	3785	509	2300	3413	450	843	1725	520	1720	2410	450
	1050	2210	375	2304	3383	405	2400	3470	400	1155	1700	428	1950	2540	410
4 year U S	856	2333	425	1977	3125	482	2428	3507	435	938	1685	490	1980	2540	438
	1033	2200	354	2316	3199	398	2568	3542	390	1215	1580	398	2080	2580	400
1 year Liberia[g]	700	2500	487	2100	4600	545	2400	3850	457	775	1900	557	1925	3125	480
	1000	2500	370	2475	4375	470	2550	3850	420	1100	1750	427	2275	3210	453
2 year Liberia	742	2008	427	2225	3766	466	2675	3375	387	800	1900	560	1950	2510	420
	933	2100	350	2700	3725	393	2900 (?)	3533	380	1050	1900	466	2100	2625	400
3 year Liberia	1000	2350	440	2150	3850	500	2600	3050	370	848	1925	580	2050	2525	430
	1150	2325	360	2600	3325	380	2625	3200	380	1075	1675	450	2200	2525	380
4 year Liberia	900	1975	380	2175	3550	470	2750	3225	370	875	1775	540	2125	2450	380
	1225	2125	320	2550	3025	370	2800	3075	340	1125	1750	450	2400	2725	360

[a] First line 60 min—cure at 275 F. Second line 90 min—cure at 275 F.
[b] First line 45 min—cure at 275 F. Second line 90 min—cure at 275 F.
[c] First line 45 min—cure at 290 F. Second line 90 min—cure at 290 F.
[d] First line 20 min at 300 F. Second line 30 min at 300 F.
[e] First line 45 min at 275 F. Second line 90 min at 275 F.
[f] Average temperature 77 F.
[g] Average temperature 85 F.

TABLE IV.—RESULTS OF TEST B.

Aging Time	Compound No. 1			Compound No. 2			Compound No. 3			Compound No. 4			Compound No. 5		
	300 per cent			300 per cent			300 per cent			300 per cent			200 per cent		
	Modulus	Tensile Strength	Elongation	Modulus	Tensile Strength	Elongation	Modulus	Tensile Strength	Elongation	Modulus	Tensile Strength	Elongation	Modulus	Tensile Strength	Elongation
Original	680	2508	602	872	2244	669	1547	3838	569	1887	3485	490	862	3496	491
85 days at 25 C	740	2637	600	1027	2380	617	1640	4004	569	2018	3452	475	858	3660	495
170 days at 25 C	798	2614	588	1208	2488	555	1770	3882	532	2088	3317	448	972	3343	453
340 days at 25 C	723	2498	578	1200	2460	570	1712	3760	538	1777	2590	408	986	3357	450
680 days at 25 C	788	2516	566	1397	2390	495	1855	3773	515	1652	1723	322	1155	3276	396
1360 days at 25 C	852	2438	557	1503	2526	489	1960	3378	462	...	1030	231	1438	3025	347
85 days at 30 C	670	2492	590	863	2318	670	1666	3952	572	1920	3232	458	855	3342	450
170 days at 30 C	758	2523	592	1008	2400	656	1780	3963	545	2115	3120	432	1053	3137	420
340 days at 30 C	793	2597	580	1062	2454	644	1810	3890	540	1753	2542	394	1075	3066	410
680 days at 30 C	787	2474	560	1186	2484	594	1883	3625	500	...	1525	282	1360	3246	400
1360 days at 30 C	828	2520	572	1474	2510	500	2023	3378	472	...	820	177	1498	3190	350

are concerned at this point are plotted with time as the abscissa and the properties as percentages as the ordinate. The other curves represented by diagonal lines will be discussed later. For test B in which the elevated temperature tests were run both by the test tube method[4] and by the oven method,[5] the test tube results were plotted for the reason that certain of the oven data, particularly for compound No. 2, were found to be badly affected by contamination by other stocks (1).

The logarithmic time scale was chosen for convenience in presenting the data for all test temperatures on a single chart. In plots such as these, the curves for those properties which change most characteristically with time of aging will show a similar behavior at all test temperatures provided that the aging intervals are properly selected and that the same deterioration mechanism prevails at all the test temperatures. It should be remembered that the time scale is logarithmic and may be misleading at first glance for this reason. The apparent acceleration of deterioration indicated by some of the curves is due to the logarithmic scale. Actually the changes per unit time of aging decrease with increased time of aging.

Mandel, Steel, and Stiehler (3) in analyzing the data from test A found that for the GR-S stock the breaking elongation when plotted *versus* square root of time gave straight lines which permitted the calculation of a rate for each test temperature from which an activation energy could be calculated. This was 20,600 cal per mole. However for the modulus change of this particular stock and the property changes for the other stocks in the test, plots of this type did not produce straight lines. For the very similar GR-S stock of test B a plot such as suggested for breaking elongation *versus* square root of time did not give straight lines. This procedure is therefore of most limited usefulness and could not be applied to the other nine materials in these two programs.

A glance at the figures will show that in certain cases, over most of the temperature range, the pattern of deterioration appears to be similar. This is particularly the case for the GR-S stocks of both programs, the nitrile rubber stocks of both programs, and the neoprene stock of test A. For the natural rubber stocks of both series and the GR-I stock of test A the pattern of behavior appears to be different at each test temperature. One reason for this behavior in the natural rubber stocks is the phenomenon mentioned in the earlier report of the nonhomogeneous deterioration evidenced by the appearance of a crust on the surface of the test specimen. This was apparent at test temperatures of 125 and 150 C for compounds Nos. 3 and 4 of test B and at 121 C for the natural rubber stock of test A. However, it was not apparent in the case of the natural rubber stock cured with tetramethylthiuramidisulfide (TMTD) of test B.

However this phenomenon does not explain the irregular behavior of certain of the stocks at all test temperatures (in particular compound No. 1 of test B and compound No. 4 of test A) and certain of the other stocks at the highest test temperature. In these cases the modulus changes at different aging temperatures are quite different. In general the higher the test temperatures,

[4] Tentative Method of Test for Heat Aging of Vulcanized Natural or Synthetic Rubber by Test Tube Method (D 865 – 52 T), 1952 Book of ASTM Standards, Part 6, p. 386.

[5] Standard Method of Test for Accelerated Aging of Vulcanized Rubber by the Oven Method (D 573 – 52), 1952 Book of ASTM Standards, Part 6, p. 237.

the lower the modulus becomes compared with the next lowest temperature. It is apparent that the balance between chain scission and cross linking changes with the aging temperature, with greater chain scission at the higher temperature and greater cross linking at the lower temperature. This observation has been made by others (**2**, **4**, **5**, **7**, **8**, **9**, **10**). Apparent exceptions to this are the GR-I compound of test A and the natural rubber—TMTD stock of test B in which the increase in modulus at 70 C is greater than that at room temperature.

For those cases in which the deterioration is apparently the same over a range of temperatures, plots can be made of the times required to produce an equal degree of deterioration at the various test temperatures *versus* the reciprocal of the absolute temperature. If a reasonably good straight line results, it would permit the calculation of the activation energy of the processes occurring and would also permit the calculation of the time required at any temperature (excluding very high temperatures) to produce an equal degree of deterioration when the time is known for one temperature.

In order to determine the times required at different temperatures to produce the same degree of deterioration, it was necessary to select the properties of each compound which showed the most regular and characteristic changes and to select, if possible, for each property a degree of deterioration which had been attained at all the test temperatures. In some cases this was not possible either at the highest or lowest test temperature, while in other cases a short extrapolation was necessary. In the following table are shown the values selected for each compound along with the temperature range over which the deterioration processes appear to be the same:

Compound	Cure Time, min.	Modulus Change, per cent	Tensile Strength Change, per cent	Elongation Change, per cent	Temperature Range
Test A					
No. 1......	60	+70	...	−24	RT-100 C
	90	+60	...	−30	RT-100 C
No. 2......	45	...	−20	−20	RT-100 C[a]
	90	...	−20	−20	RT-100 C[a]
No. 3......	45	+24	...	−12	RT-121 C
	90	+20	...	−12	RT-121 C
No. 4......	20	Irregular behavior			
	30	Irregular behavior			
No. 5......	45	+30		−20	RT-121 C
	90	+20		−20	RT-121 C
Test B					
No. 1......	...	...	−16	...	RT-150 C[a]
No. 2......	...	+60	...	−28	RT-150 C
No. 3......	...	...	−16	−16	RT-100 C
No. 4......	...	...	−80	−60	RT-100 C
No. 5......	...	+80	...	−40	RT-125 C

[a] Of doubtful regularity because of wide variations in modulus for equal degrees of deterioration in tensile strength or elongation.

The value of the deterioration selected will influence the slope of the line relating time to $\dfrac{1}{\text{temperature (Abs.)}}$ somewhat. However, in each case a check was made at both higher and lower deteriorations to the extent permitted by the data and the calculations showed only a minor effect.

The Arrhenius-type plots of the times required at the various test temperatures to produce the above degrees of deterioration are shown, also in Figs. 1 to 15 except for the case of compound No. 4 of test A. In these plots the reciprocal of the absolute temperature is plotted as the abscissa and the times required to produce equal degrees of deterioration as the ordinate. It will be noted that in most cases the plotted points describe a straight line. For the reasons previously given some of the points for the highest temperatures of aging do not fall on the lines drawn. On the other end of the temperature scale the values for room temperature aging may be either above or below the line. This is no doubt due to testing errors resulting from the long time intervals between tests for the room temperature aging. An inspection of the curves for the various physical properties *versus* aging time shows that they are more irregular for the room temperature aging than for the high temperature aging.

From the best straight lines drawn through the points representing equal degrees of deterioration an apparent activation energy of the aging processes can be calculated. These are shown in the following table:

ACTIVATION ENERGIES—CAL PER MOLE.

Compound	Cure Time	Based on Modulus Increase	Based on Tensile Decrease	Based on Elongation Decrease
Test A				
No. 1 GR-S..........................	60	20 500	...	20 500
	90	19 000	...	18 500
No. 2 Natural rubber................	45	...	21 600	20 800
	90	...	22 400	20 950
No. 3 Neoprene......................	45	18 300	...	18 300
	90	17 400	...	17 200
No. 4 GR-I..........................	20	...	...	...
	30	...	...	...
No. 5 Nitrile rubber................	45	21 900	...	21 900
	90	21 100	...	22 000
Test B				
No. 1 Natural rubber TMTD-cured.................		...	28 450	...
No. 2 Nitrile rubber TMTD-cured.................		19 000	...	19 200
No. 3 Natural rubber tread......................		...	25 600	25 500
No. 4 Natural rubber tread without age resister.......		...	23 750	23 750
No. 5 GR-S tread................................		21 200	...	20 800

It will be noted that for the GR-S and nitrile rubber stocks of the two tests the activation energies agree quite well. For the natural rubber tread the agreement is not good, although the two stocks are very similar in composition. The high value for compound No. 1 of test B is questionable for the reasons mentioned earlier. The values for the activation energies for the GR-S, neoprene, and nitrile rubber are in the range of 19,000 ± 2000, while the natural rubber stocks (excluding compound No. 1 of test B) are in the range of 20,000 to 25,000.

The higher the value for the activation energy the greater is the temperature dependence of the rate limiting step in the deterioration process. Thus if 70 C is considered as a reference temperature, a stock having a high activation energy will perform relatively better at lower temperatures and poorer at higher temperatures than one with a low activation energy. For example, one hour at 70 C for a material having an activation energy of 19,000 is equivalent to 41 hr at 30 C and 0.005 hr at 150 C, while for one with an activation energy of 25,000, the corresponding values are 153 hr and 0.0008 hr. Since these differences are quite large it is obvious that for these and similar materials, a test run

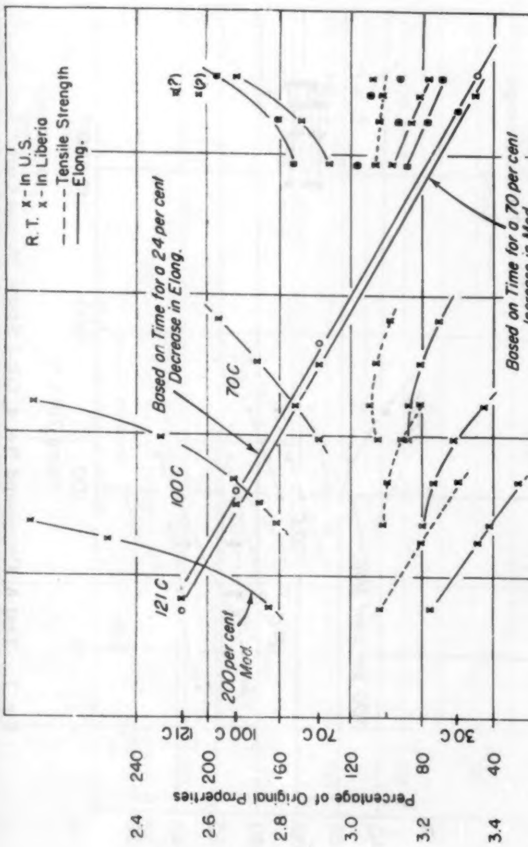

Fig. 1.—Test A, Compound No. 1, GR-S Stock, 60-min. Cure.

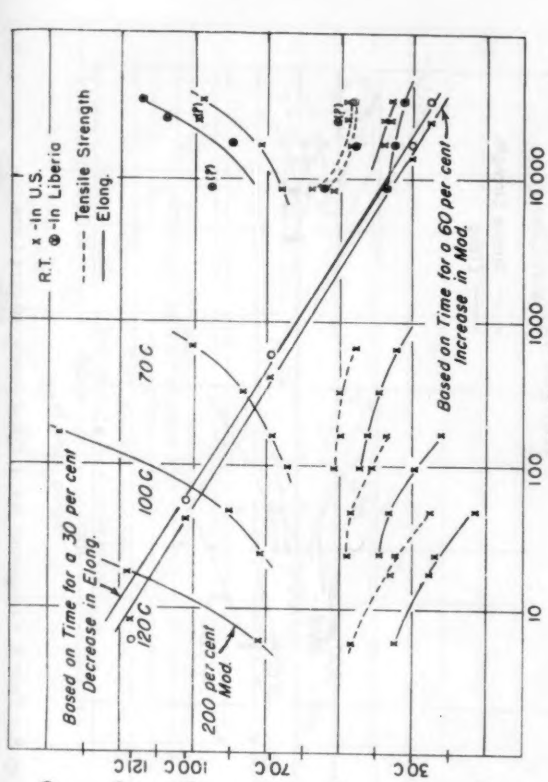

Fig. 2.—Test A, Compound No. 1, GR-S Stock, 90-min. Cure.

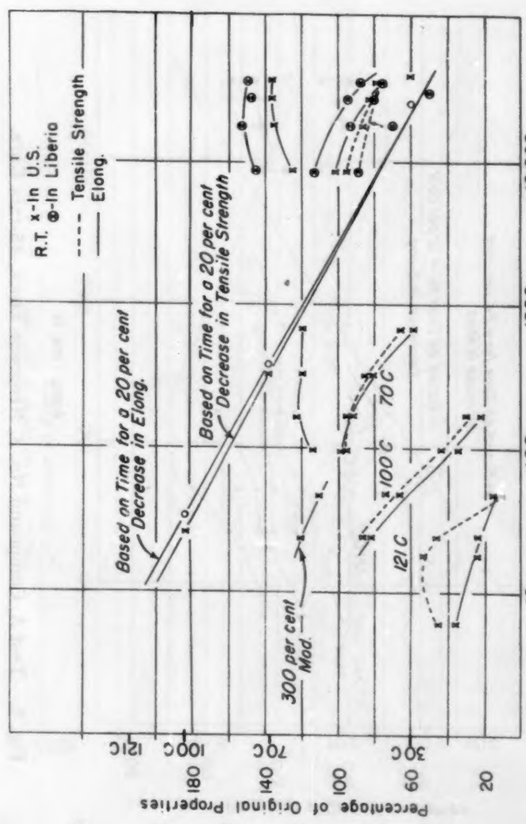

Fig. 3.—Test A, Compound No. 2, Natural Rubber Stock, 45-min Cure.

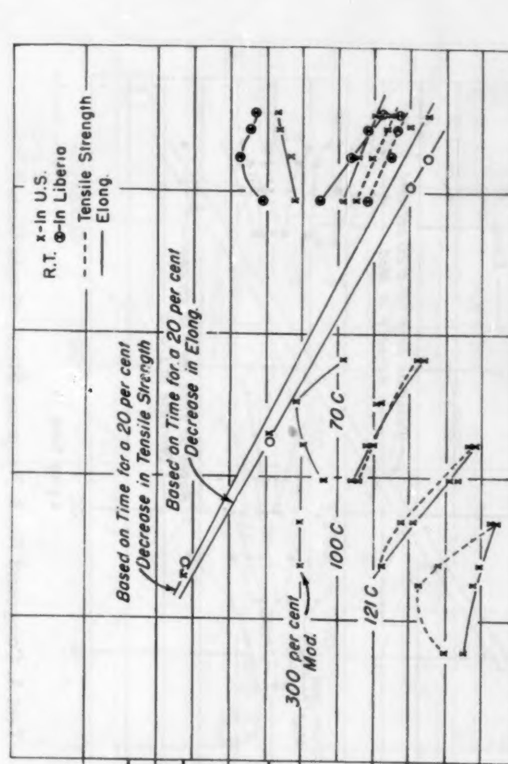

Fig. 4.—Test A, Compound No. 2, Natural Rubber Stock, 90-min Cure.

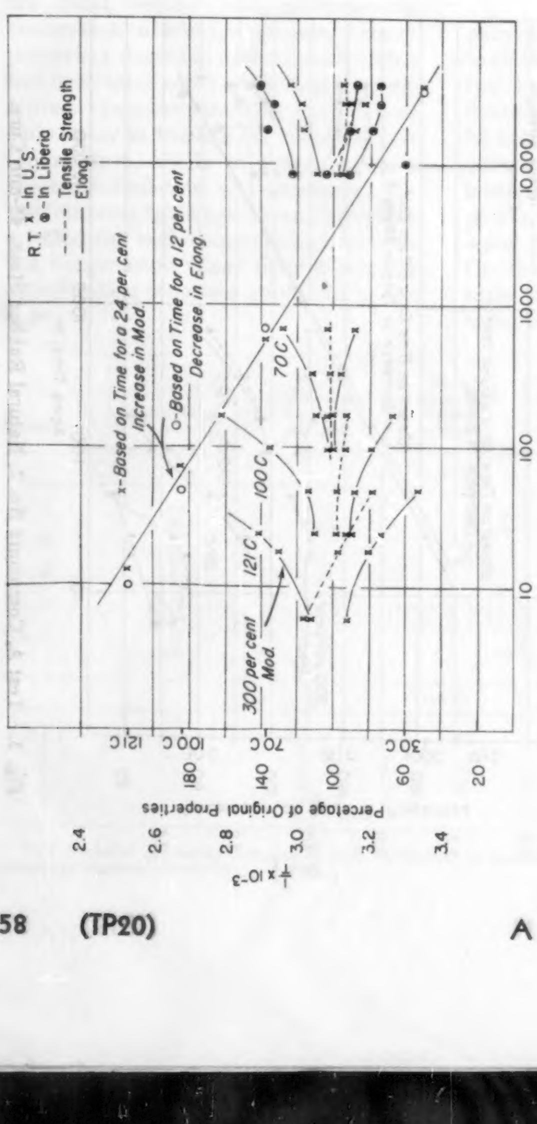

Fig. 5.—Test A, Compound No. 3, Neoprene Stock, 45-min Cure.

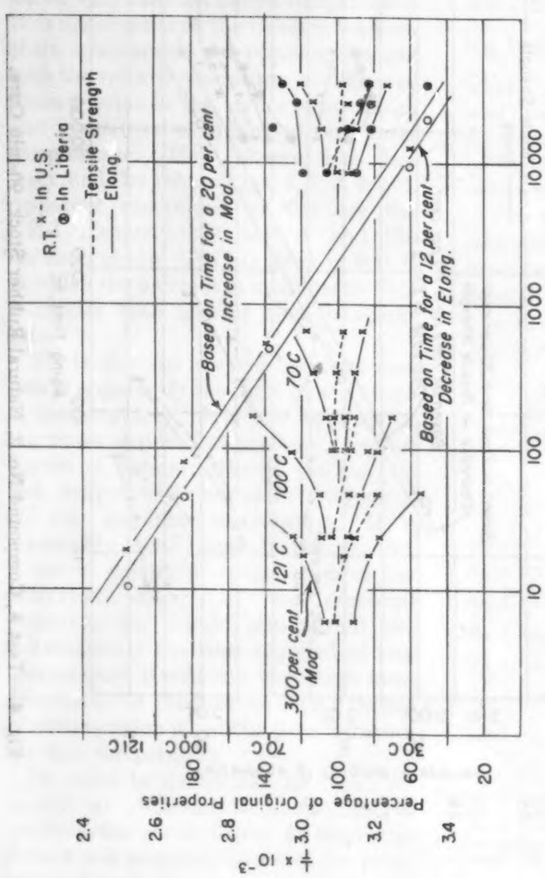

Fig. 6.—Test A, Compound No. 3, Neoprene Stock, 90-min Cure.

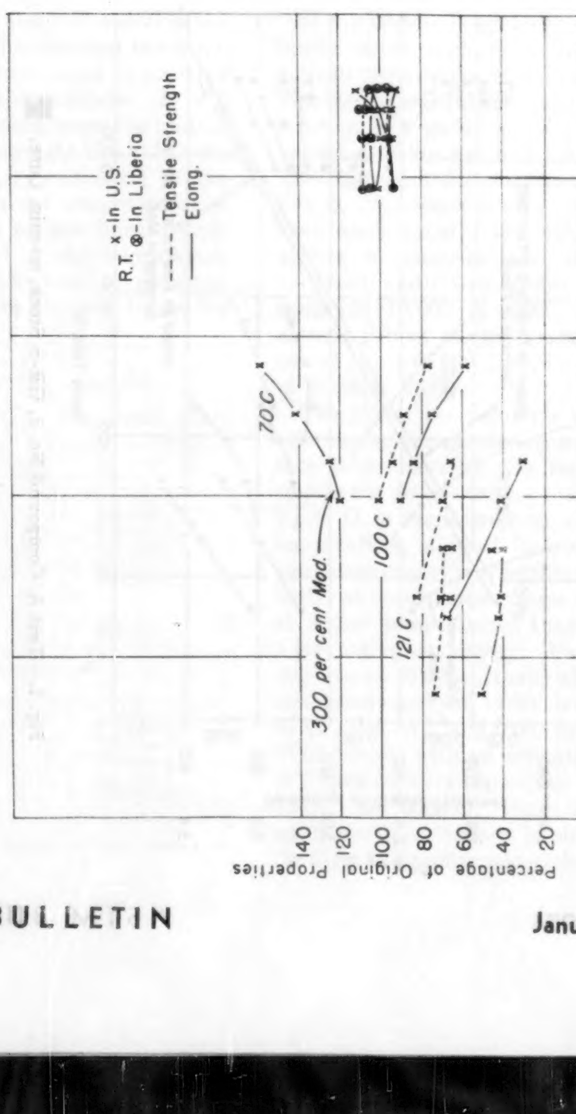

Fig. 7.—Test A, Compound No. 4, GR-I Stock, 20-min Cure.

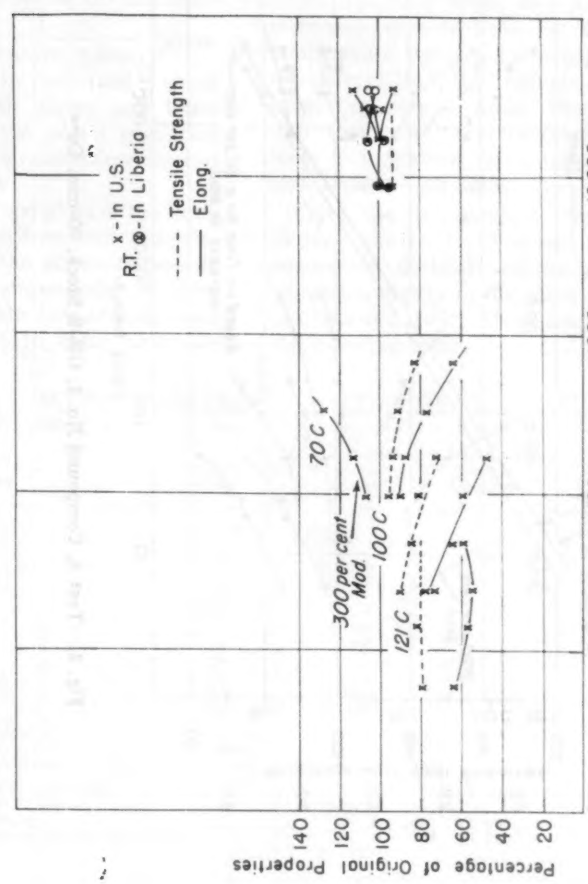

Fig. 8.—Test A, Compound No. 4, GR-I Stock, 30-min Cure.

Fig. 7.—Test A, Compound No. 4, GR-I Stock, 20-min Cure.

Fig. 8.—Test A, Compound No. 4, GR-I Stock, 30-min Cure.

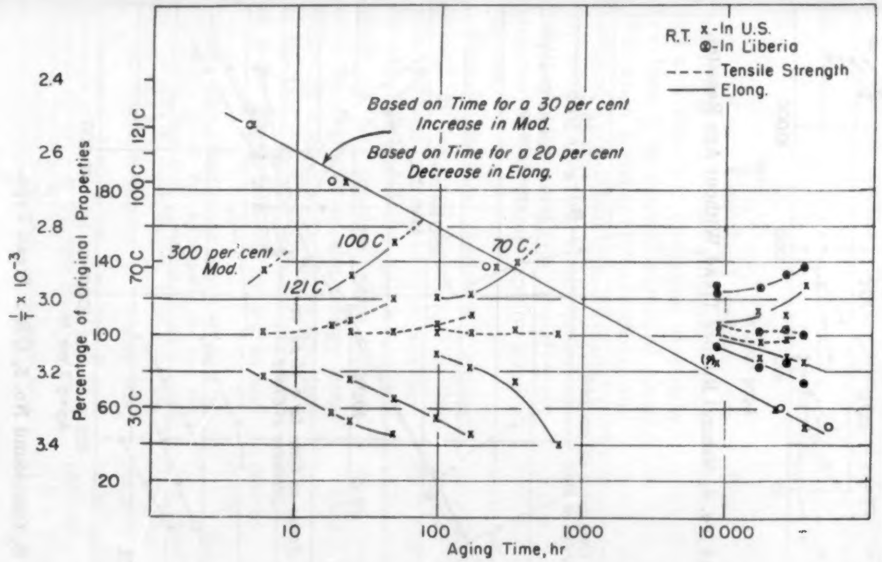

Fig. 9.—Test A, Compound No. 5, Nitrile Rubber Stock, 45-min Cure.

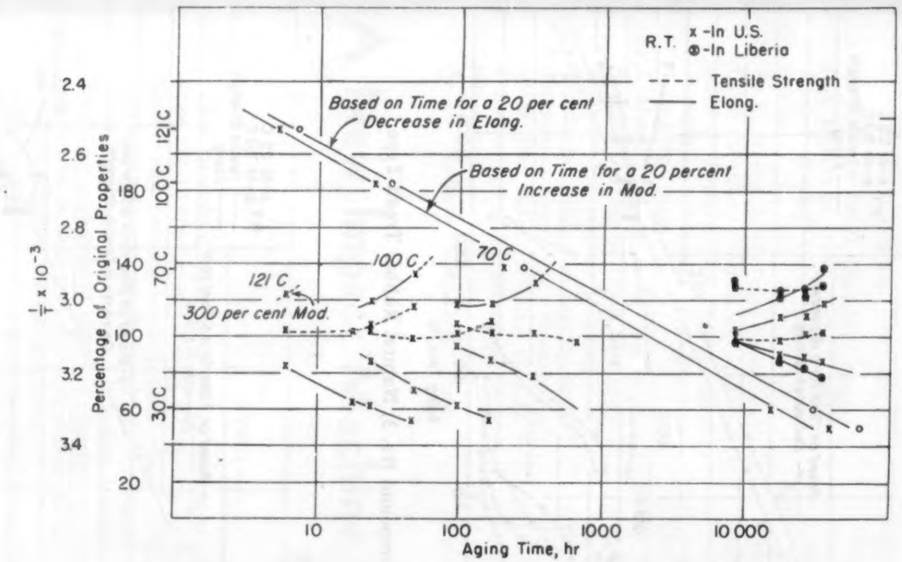

Fig. 10.—Test A, Compound No. 5, Nitrile Rubber Stock, 90-min Cure.

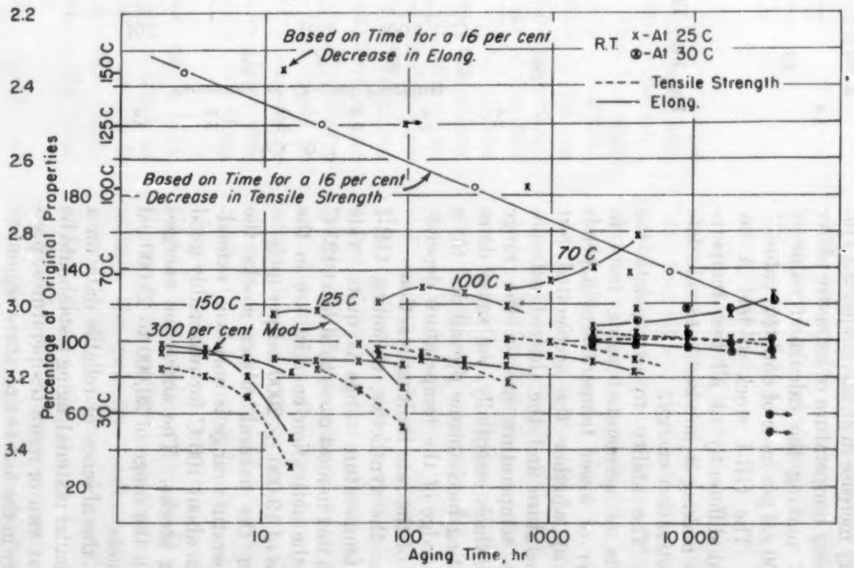

Fig. 11.—Test B, Compound No. 1, Natural Rubber, TMTD Cure.

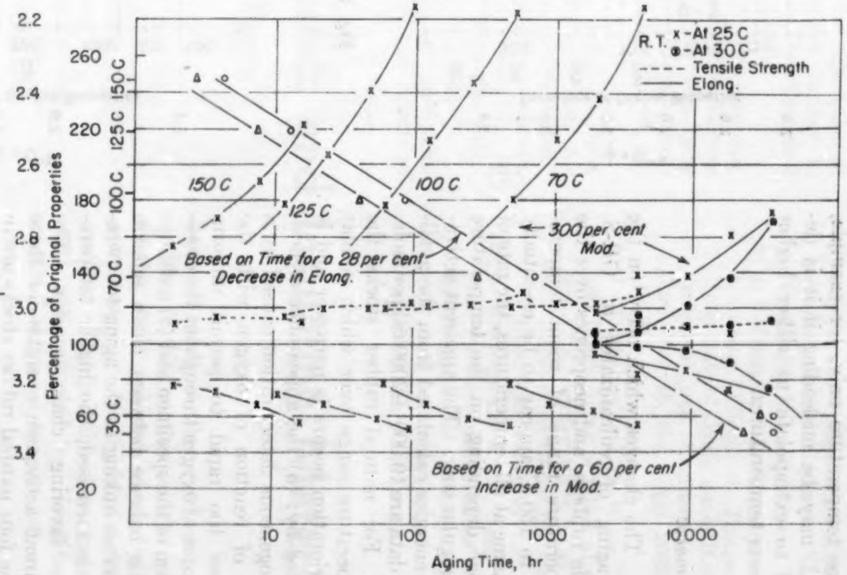

Fig. 12.—Test B, Compound No. 2, Nitrile Rubber, TMTD Cure.

at one temperature only, for example, 70 C, may be misleading if it is desired to extrapolate to either higher or lower temperatures.

Summary:

1. The changes which occur on the air aging of vulcanizates of GR-S, nitrile rubbers, and neoprenes over the temperature range of room temperature to 150 C appear to be essentially the same at all temperatures, the rate of change depending on the temperature in a regular way. The apparent activation energies calculated from the available data are 19,000 ±2000 cal per mole.

2. For natural rubber stocks the temperature range over which similar deterioration occurs is narrower and is limited by: (*a*) the appearance of nonhomogeneous deterioration caused by a rate of reaction of oxygen with the rubber too rapid to permit uniform diffusion of oxygen throughout the cross-section of the specimen and (*b*) a change in the balance between chain scission and cross linking as the aging temperature is increased, the higher temperatures favoring chain scission. The apparent activation energies for three of the four natural rubber stocks are in the range of 20,000 to 25,000 cal per mole. The fourth natural rubber stock, that vulcanized with TMTD, exhibits a steady increase in chain scission with increasing temperature of exposure above 70 C making the calculated value of 28,450 cal per mole of doubtful value.

3. The GR-I stock of test A behaved differently at all test temperatures making it impossible to calculate an activation energy.

4. The ability to extrapolate the results of accelerated aging tests to higher or lower temperatures depends on: (*a*) whether the accelerated test temperature and the desired extrapolated temperature are in the range over which essentially the same deteriorating mechanisms prevail and (*b*) a knowledge of the temperature dependence of the rate limiting reaction.

For the synthetics, excluding GR-I the temperature range is quite wide extending in most cases to at least 125 C and the activation energies are in the range of 19,000 ± 2000 cal per mole.

For the natural rubber stocks the temperature range is narrower, extending to about 100 C for reasonably good aging stocks. The activation energies are in the range of 20,000 to 25,000 cal per mole.

In the absence of reliable data on a particular material, aging tests should be run at two or more temperatures, preferably in the low temperature region, to establish a basis for extrapolation.

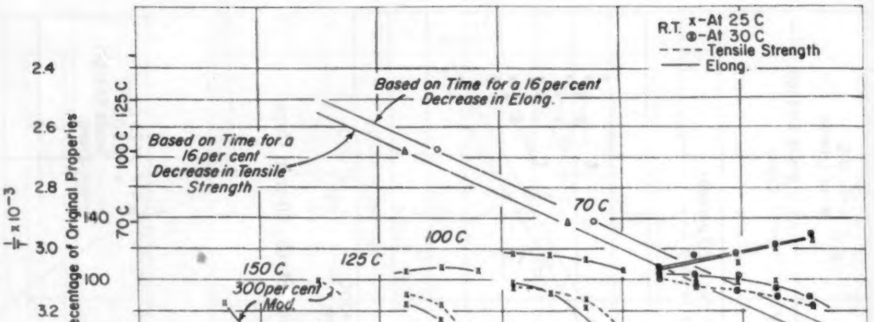

Fig. 13.—Test B, Compound No. 3, Natural Rubber Tread Type.

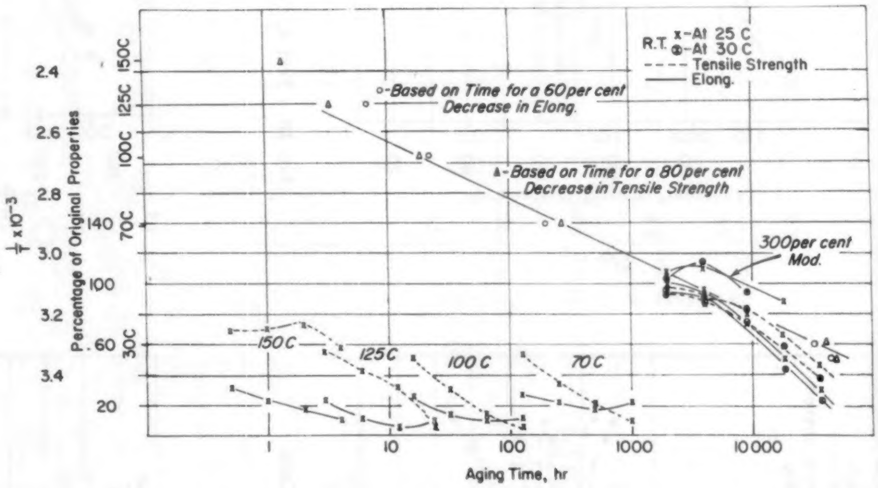

Fig. 14.—Test B, Compound No. 4, Natural Rubber Tread Without Age Resister.

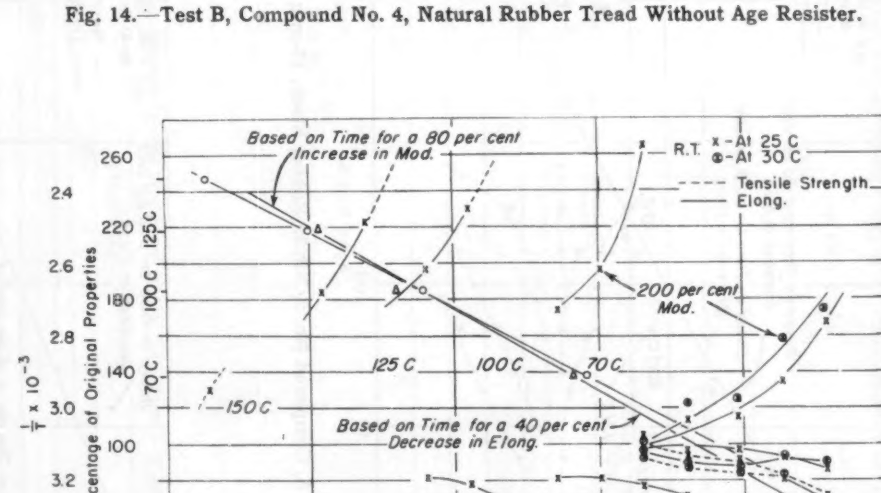

Fig. 15.—Test B, Compound No. 5, GR-S Tread Type.

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A New Impact Machine for Plastics and Insulating Materials

By Robert Burns[1]

SYNOPSIS

The pendulum type excess energy impact machine (Izod) has been used since the 1920's for engineering evaluation and commercial application of plastics and electrical insulation materials. As a national standard[2] it plays an important part in civilian and military procurement.

A recognized source of error in testing low-strength plastics and electrical insulating materials of different densities by the Izod method is the toss factor, that is, that part of the pendulum energy consumed in tossing away the broken half of the test specimen.

This paper discusses a machine which is similar to the Izod but utilizes the principle that if the specimen is in motion it will contain the kinetic energy to toss itself and such energy will not appear as an error in the impact strength reading. Design features and representative data are included.

THE Izod method for measuring the impact strength of plastics and electrical insulating materials has been a recognized standard since 1926 when Werring (1)[3] introduced the design of a pendulum type low-capacity excess-energy device to determine the ability of the relatively low-strength organics to withstand rapidly applied stresses.

Perhaps the most persistent criticism leveled at the Izod technique[2] is the so-called toss factor, a term popularized by Maxwell and Rahm (2) in a recent study of this problem. The term is used to characterize the energy consumed in tossing away the broken half of the test specimen, a factor discussed at some length in 1938 by Burns and Werring (3) and Zinzow (4) as a source of substantial error in evaluating low-strength materials of differing densities. In spite of some feeling that the engineering significance of the error has been overemphasized in a justifiably zealous effort to improve matters, its importance cannot be ignored in view of the fact that many of our most useful plastics such as phenolics, ureas, melamines, polystyrene, etc., are in the low-strength category and in further view that the Izod method is a recognized bulwark of commercial qualification and procurement, both civilian and military.

Many attempts have been made to reduce the toss error to a reasonably tolerable level and all have been successful. They fall generally into three types:

1. The specimen is hit with a blow just great enough to crack or break as described by several investigators (5, 6, 7,8,9). All such methods are concededly tedious but probably the most accurate.

2. The excess energy system of Maxwell and Rahm is based on the principle that if the specimen is in motion it will contain kinetic energy to toss itself and such energy will not appear as an error in the impact strength reading. This principle was previously used with success by Hopkins (10) in the design of a tension impact machine.

3. The compromise ski-ball procedure of Stock (11), and Bailey and Ward (12) attempts to combine the convenience of the excess energy system with the greater accuracy of the just-enough-energy technique. It is sometimes referred to as the "slightly excess energy" system.

The statement that all such methods have been successful is predicated on the fact that all will yield values for brittle materials more or less independent of density, whereas no such claim can be made for the Izod. However, Rowe (13), in a study of the toss factor as it affects British Specification 771, concludes that technically acceptable impact strengths can be computed under certain circumstances from data taken with an Izod machine.

From the above, it is apparent that the toss factor can be reduced to a tolerable level at the sacrifice of convenience. The purpose of this paper is to describe briefly a machine which accomplishes a similar purpose but with an ease of operation which approaches the Izod. It is a pendulum-type device identical to the Izod with the exception that the test specimen is clamped in the tup and the striker is stationary. It utilizes the principle previously employed by Hopkins, and Maxwell and Rahm; that is, the energy to toss is supplied by the falling specimen. It is called the Dozi (Izod spelled backward) and is shown in Fig. 1.

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to ASTM Headquarters, 1916 Race St., Philadelphia 3, Pa.

[1] Bell Telephone Laboratories, Murray Hill, N. J.

[2] Tentative Methods of Test for Impact Resistance of Plastics and Electrical Insulating Materials (D 256 – 47 T), 1952 Book of ASTM Standards, Part 6, p. 1025.

[3] The boldface numbers in parentheses refer to the list of references appended to the paper.

Whereas the Izod tup permits a substantial amount of design freedom, the Dozi tup must act as a vise, clamping the specimen over the entire half-length in such a manner that absorption of energy by deformation of the vise-tup is minimized. In the machine herein described the clamping system is shown in Fig. 1 Inset; other and better ways could no doubt be devised. It will be apparent that the combination of a rigid clamp with the necessity of locating the center of percussion at the striking edge precludes a machine of very low capacity. However, this is difficult even in the Izod for reasons outlined by Stock and fully appreciated by impact technicians. The present Dozi has a capacity of 2.38 ft-lb; this could probably be reduced by further design effort.

Since the only claim for the Dozi over the many methods described in the literature is convenience, a few words in explanation may not be amiss. The time required for breaking a specimen in the Dozi is longer than for the Izod, but not objectionably so, and additional experience may permit further reduction. Perhaps the greatest difference is a psychological one: the technologist has a natural aversion to exerting stresses on the pendulum assembly, even the relatively mild ones resulting from clamping the specimen. Although no damage to a reasonably strong machine should result, there is always an intuitive feeling that the pendulum should be left severely alone. Obviously, this is not possible with the Dozi.

Data comparing the Dozi with other methods are given in Table I. It will be noted that the Dozi machine rates the high-density mica-filled phenolic as appreciably weaker than the wood flour-filled phenolic, thus bringing the data in accord with field experience.

After perusing the data, one may well ask: What is the true impact strength? Why must the Dozi be assessed by the admittedly inexact criterion of field experience? Why not compare it to an absolute standard? The answer is that at the present state of the art impact strength is a statistical entity which by one method or another attempts to equate many imponderables such as molding process, notching variables unavoidable inhomogeneity of material, errors in the testing method, etc. This has been well established; however, a few data from Telfair and Nason are an impressive illustration. The material is general-purpose phenolic:

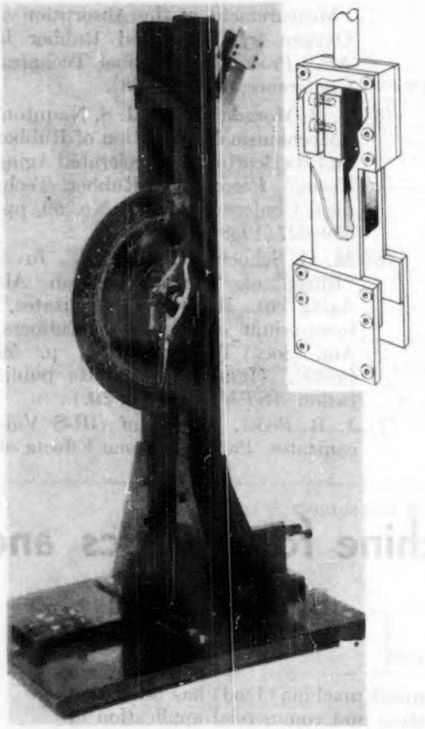

Fig. 1.—Dozi Impact Machine: Inset Clamping System of Holding Specimen

Percentage of Specimens Broken	Impact Strength, ft-lb per in. of notch
0	0.10
5	0.11
11	0.12
22	0.13
45	0.14
90	0.15
100	0.16

TABLE I—IMPACT STRENGTHS BY VARIOUS METHODS, FT-LB PER INCH OF NOTCH

	Just Enough Energy—Falling Ball		Slightly Excess Energy—Ski-Ball (11)	Fly-wheel (2)	Dozi Pendulum	Izod Pendulum	Specific Gravity
	To Break (9)	To Crack (8)					
Wood flour-filled phenolic	0.22	0.17	0.21	0.14	0.22	0.30	1.35
Wood flour- and flock-filled phenolic	0.26	...	...	...	0.25	0.34	1.35
Mica-filled phenolic	0.16	0.045	0.13	0.13	0.14	0.32	1.9
Cellulose-filled melamine	0.07	...	0.097	0.14	0.08	0.23	1.5
Asbestos-filled melamine	0.15	...	0.19	...	0.19	0.32	1.7
Rubber-filled phenolic	...	...	...	...	0.62	0.54	1.25
Rag-filled phenolic	...	...	...	...	1.10	0.94	1.46
Asbestos-filled diallyl phthalate	...	...	...	...	0.05	0.28	1.65
Unfilled epoxide	...	...	...	...	0.27	0.42	1.19
Silica-filled epoxide	...	...	...	...	0.16	0.36	1.62
Unfilled styrene-polyester	...	...	...	...	0.07	0.27	1.22
Silica-filled styrene polyester	...	...	...	...	0.25	0.30	1.60

In the above case the authors chose the statistical mean (0.142) as the impact strength.

From the Dozi-Izod comparative data it will be evident that the toss factor loses significance at values in the neighborhood of 0.5 ft-lb per in. of notch. This confirms previous work.

Conclusion

The Dozi excess-energy impact machine appears to provide for low-strength plastics a convenient method of evaluation which reduces the toss-factor error to a level commensurate with normal engineering needs.

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Electrolytic Etching of Stainless Steels

Ed. Note.—In this issue of the Bulletin there are three contributions which deal with an electrolytic etching evaluation test for stainless steel. The method itself and its use as a supplement (and sometimes a substitute) for the Tentative Recommended Practice for Boiling Nitric Acid Test for Corrosion-Resisting Steels (A 262, 1952 Book of ASTM Standards, Part 1, p. 998) were described by M. A. Streicher in a paper which appeared in ASTM Bulletin, No. 188, February, 1953, p. 35.

In view of the savings in time and expense that might be achieved by the use of this test, an effort was made by Subcommittee IV on Methods of Corrosion Testing, of ASTM Committee A-10 on Iron-Chromium, Iron-Chromium-Nickel, and Related Alloys to explore its applicability and to correlate its results with those of boiling nitric acid tests on duplicate specimens. This took the form of a series of "round-robin" tests in which several laboratories cooperated. The results of this effort are covered by the report on wrought alloys prepared by M. A. Streicher for the subgroup concerned with this test program. This appears on page 63 of this issue.

The cooperation of the Alloy Casting Inst. was secured in extending the studies to some alloys in cast forms. The findings of the investigators for the ACI are covered by the paper by F. H. Beck, N. D. Greene, Jr., and M. G. Fontana on page 68.

Finally, the tests on some standard cast alloys were supplemented by similar studies on certain special cast alloys undertaken by G. W. Jackson and W. A. Luce of The Duriron Co. as covered by their paper on page 71.

It seems evident from the observations reported in these papers and from rather considerable use of the electrolytic etching technique by both producers and consumers of these alloys that the etching test is quite satisfactory for its intended purpose.

Subcommittee IV is actively considering action that would lead to the adoption of the etching technique as a recognized supplement to the boiling nitric acid test which it would replace to some extent. Mr. F. L. LaQue, chairman of Subcommittee IV of Committee A-10, will welcome comments on this proposal from anyone who is interested in this test or has had experience with it. He may be addressed in care of The International Nickel Co., Inc., 67 Wall St., New York 5, N. Y.

Subcommittee IV wishes to express its thanks to the authors of these papers and to those who participated in the test programs described.

Results of Cooperative Testing Program for the Evaluation of the Oxalic Acid Etching Test*

Prepared by M. A. Streicher[1]

In the February, 1953, issue of the ASTM Bulletin an oxalic acid etching technique for stainless steels was described by the author.[2] This etching technique is being used by du Pont as a supplement to the boiling nitric acid test to screen out 50 per cent or more of some grades of stainless steel as satisfactory without having to subject them to the standard boiling nitric acid test. Since a rapid method for the detection of susceptibility to intergranular corrosion would be of great value to all, Subcommittee IV on Methods of Corrosion Testing of ASTM Committee A-10 on Iron-Chromium, Iron-Chromium-Nickel, and Related Alloys decided to carry out a cooperative testing program to evaluate this procedure for possible ASTM adoption.

Arrangements were made for 18 laboratories to compare the two methods for the evaluation of representative samples of stainless steels. At the request of F. L. LaQue, Chairman of Subcommittee IV, the Engineering Research Laboratory, E. I. du Pont de Nemours and Co., Inc., supplied each of the 18 laboratories (Table I) with seven stainless steel specimens in duplicate (Tables II and III) for this purpose. The following tests were conducted:

1. Boiling nitric acid tests on 7 specimens.
2. Electrolytic etching tests on 7 specimens and the preparation of 7 photomicrographs.

The purpose of the oxalic acid test as used by du Pont is to identify those steels which are certain to have nitric acid corrosion rates less than the maximum permissible (see below) and thus to screen out and make unnecessary more than half of the nitric acid tests which would otherwise be performed. According to the screening procedure all steels having a "step" or

TABLE I.—PARTICIPANTS AND LOCATION OF TESTS.

Allegheny Ludlum Steel Corp., Research Laboratory, Brackenbridge, Pa.
Alloy Casting Institute, The Ohio State University, Columbus, Ohio.
A. O. Smith Corp., Metallurgical Department, Milwaukee, Wis.
Armco Steel Corp., Middletown, Ohio.
The Babcock and Wilcox Co., Tubular Products Division, Beaver Falls, Pa.
Combustion Engineering-Superheater, Inc., Chattanooga Division, Chattanooga, Tenn.
Crucible Steel Company of America, Research Laboratory, Harrison, N. J.
Eastern Stainless Steel Corp., Baltimore, Md.
E. I. du Pont de Nemours and Co., Inc., Engineering Research Laboratory, Wilmington, Del.
Electrometallurgical Co., Technical Service and Development Laboratory, Niagara Falls, N. Y.
General Electric Co., Nucleonics Division, Hanford Works, Richland, Wash.
Globe Steel Tubes Co., Milwaukee, Wis.
The International Nickel Co., Inc., Research Laboratory, Bayonne, N. J.
The Midvale Co., Philadelphia, Pa.
National Bureau of Standards, Washington, D. C.
Republic Steel Corp., Central Alloy District, Massillon, Ohio.
Sam Tour and Co., Inc., New York, N. Y.
United States Steel Co., Homestead District Works.

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* Summary compiled for a subgroup of Subcommittee IV of Committee A-10, composed of M. H. Brown, P. Payson, M. A. Scheil, and G. M. Riegel, and submitted by them as a supplement to the A-10 report for 1953.

[1] Engineering Research Laboratory, E. I. du Pont de Nemours and Co., Inc., Wilmington, Del.

[2] Michael A. Streicher, "Screening Stainless Steels from the 240-Hr Nitric Acid Test by Electrolytic Etching in Oxalic Acid," ASTM Bulletin, No. 188, February, 1953, p. 35.

"dual" etch structure are assumed (on the basis of about one thousand correlatory tests) to have such low rates and, therefore, not to require nitric acid testing. Steels which have one or more grains completely surrounded by ditches in the oxalic acid etch structure are considered questionable and must be submitted for nitric acid testing. On such steels there may be some undermining and dropping of grains in the nitric acid test, but the corrosion rates will in most cases be less than the maximum permissible. Thus, no *failing* nitric acid rates are predicted by means of the oxalic acid etch structures. The oxalic acid etch evaluation is, therefore, considered to be in agreement with the nitric acid corrosion rate if steels having either a "step" or a "dual" structure have nitric acid corrosion rates less than the following maximum permissible rates:

Types 304 and 316....0.0015 in. per month
Type 304L (after 1 hr at 1250 F)........0.0020 in. per month

Results and Discussion

The results obtained in the form of reports from each of the 18 participating laboratories are summarized in Tables IV and V and Figs. 1 to 7. In Table IV the 5-period average nitric acid corrosion rates are given. All participants agree that specimens Nos. 1, 3, 4, 5, and 6 have passing rates and that specimens Nos. 2 and 7 have failing rates. All but one laboratory observed increasing period rates on specimen No. 3 with the exception of the first period.

Testing Conditions

Nitric Acid Test:

The nitric acid test was carried out in accordance with Tentative Recommended Practice for Boiling Nitric Acid Test for Corrosion-Resisting Steels (A 262-52 T).[3] A separate container with 600 ml of boiling 65 per cent nitric acid was used for each specimen. The test consisted of five boiling periods of 48 hr each with a new test solution for each period. Calculations of corrosion rates in inches penetration per month were made with the formula given in the standard. A density value of 8.0 was used for specimens Nos. 6 and 7 and 7.9 for all others.

Oxalic Acid Etch:

The specimens to be etched were given a metallographic polish, since photomicrographs were a part of this program. The polished surfaces were etched at room temperature in 10 per

[3] 1952 Book of ASTM Standards, Part 1, p. 998.

TABLE II.—MILL ANALYSES OF STAINLESS STEELS EVALUATED.

Specimen	Chemical Composition, per cent					
	Carbon	Manganese	Silicon	Chromium	Nickel	Molybdenum
Nos. 1 and 2..	0.063	0.80	0.37	18.31	9.30	...
No. 3......	0.028	0.94	0.35	19.16	10.86	...
No. 4......	0.021	1.29	0.55	18.91	11.08	...
No. 5......	0.020	1.06	0.37	18.30	11.02	...
Nos. 6 and 7..	0.043	1.79	0.51	17.86	13.08	2.20

TABLE III.—DESCRIPTION OF SPECIMENS.

Specimen	AISI Steel	Heat Treatment
No. 1......	Type 304	Mill annealed
No. 2......	Type 304	1 hr 1250 F, water quenched
No. 3......	Type 304L	1 hr 1250 F, water quenched
No. 4......	Type 304L	1 hr 1250 F, water quenched
No. 5......	Type 304L	1 hr 1250 F, water quenched
No. 6......	Type 316	Mill annealed
No. 7......	Type 316	1 hr 1250 F, water quenched

TABLE IV.—SUMMARY OF BOILING 65 PER CENT NITRIC ACID TEST RESULTS.

Specimen Set	240-hr Corrosion Rates in Inches per Month							Notes
	Specimen No. 1	Specimen No. 2	Specimen No. 3	Specimen No. 4	Specimen No. 5	Specimen No. 6	Specimen No. 7	
No. 1.......	0.00053	0.0065	0.0015	0.00063	0.00057	0.00093	0.0135	*A*, *B*
No. 2.......	0.0006	0.0050	0.0009	0.0006	0.0006	0.0009	0.0058	*A*, *B*
No. 3.......	0.00066	0.00363	0.00104	0.00057	0.00063	0.00083	0.00563	*A*, *B*
No. 4.......	0.0007	0.0061	0.0009	0.0006	0.0006	0.0008	0.0055	*A*, *B*
No. 5.......	0.00067	0.00576	0.00076	0.00054	0.00054	0.00074	0.00333	*A*, *B*, *C*
No. 6.......	0.0006	0.0050	0.0009	0.0006	0.0006	0.0008	0.0055	*A*, *B*, *E*
No. 7.......	0.00065	0.0093	0.00093	0.00063	0.00064	0.00097	0.0071	*A*, *B*
No. 8.......	0.00057	0.00268	0.00072	0.00057	0.00058	0.00068	0.00369	*A*
No. 9.......	0.00063	0.00927	0.00096	0.00070	0.00062	0.00085	0.00708	*A*, *B*
No. 10.......	0.0007	0.0084	0.00095	0.00062	0.00061	0.00088	0.0068	*A*, *B*, *D*
No. 11.......	0.00056	0.00628	0.00077	0.00043	0.00047	0.00084	0.00591	*A*, *B*
No. 12.......	0.0006	0.0063	0.0010	0.0006	0.0005	0.0009	0.0056	*B*
No. 13.......	0.00061	0.0135	0.00126	0.00066	0.00087	0.00107	0.0165	*A*, *B*
No. 14.......	0.0008	0.0205	0.0013	0.0007	0.0009	0.0009	0.0066	*A*, *B*
No. 15.......	0.00060	0.0065	0.00093	0.00063	0.00062	0.00085	0.0051	*A*, *B*, *F*
No. 16.......	0.00067	0.00632	0.00103	0.00065	0.00058	0.00092	0.00851	*A*, *B*
No. 17.......	0.00066	0.00418	0.00081	0.00068	0.00064	0.00089	0.00487	*A*, *B*
No. 18.......	0.00056	0.00842	0.00104	0.00066	0.00063	0.00072	0.00600	*A*, *B*
Mean.......	0.00063	0.00742	0.00098	0.00061	0.00062	0.00086	0.00683	

Notes: *A*—First 48-hr period rate higher than subsequent period rates on specimens Nos. 1, 4, 5, 6.
B—Period rates on specimen No. 3 increase with exception of first period.
C—Specimens were resquared and reground.
D—120-grit buffing wheel finish reduced first period rates.
E—Individual samples were not tested in a separate container, but specimens of each Type (304, 304L, and 316) were tested in the same container and enough 65 per cent nitric acid was put in each flask to make up 600 ml of solution for each sample in the flask.
F—The specimens were passivated for 20 min in 20 per cent nitric acid.

TABLE V.—OXALIC ACID ETCH STRUCTURE EVALUATIONS.

Specimen Set	Etch Structures							Notes
	Specimen No. 1	Specimen No. 2	Specimen No. 3	Specimen No. 4	Specimen No. 5	Specimen No. 6	Specimen No. 7	
No. 1.......	Step	Ditch	Dual	Dual	Dual	Step	Ditch	*A*
No. 2.......	Step	Ditch	Ditch	Dual	Dual	Step	Ditch	
No. 3.......	Step	Ditch	Ditch	Dual	Dual	Step	Dual	*A*
No. 4.......	Step	Ditch	Dual	Dual	Step	Step	Ditch	*A*
No. 5.......	Step	Ditch	Dual	Dual	Dual	Step	Ditch	*B*
No. 6.......	Step	Ditch	Ditch	Dual	Dual	Step	Dual	
No. 7.......	Step	Ditch	Dual	Dual	Dual	Step	Ditch	*A*, *C*, *D*
No. 8.......	Step	Ditch	Dual	Dual	Dual	Step	Dual	*A*
No. 9.......	Step	Ditch	Ditch	Dual	Dual	Step	Ditch	
No. 10.......	Step	Ditch	Dual	Dual	Dual	Step	Dual	
No. 11.......	Step	Ditch	Dual	Dual	Dual	Step	Ditch	*A*, *E*
No. 12.......	Step	Ditch	Ditch	Dual	Dual	Step	Ditch	*A*
No. 13.......	Step	Ditch	Dual	Step	Dual	Step	Dual	*A*, *B*
No. 14.......	Step	Ditch	Ditch	Dual	Dual	Step	Ditch	*A*
No. 15.......	Step	Ditch	Dual	Dual	Dual	Step	Ditch	
No. 16.......	Step	Ditch	Dual	Dual	Step	Step	Dual	*F*
No. 17.......	Step	Ditch	Ditch	Dual	Dual	Step	Ditch	*A*
No. 18.......	Step	Ditch	Ditch	Dual	Dual	Step	Ditch	*A*

Notes: *A*—On specimen No. 7, nonuniform etch structure was reported. Some areas showed dual structure only, while others contained many completely encircled grains, that is, ditch structure.
B—Specimen No. 3 was rated as having a dual structure, but photomicrograph in report shows completely encircled grains.
C—Only one sq cm of surface was etched.
D—Polishing through 000 paper in preparation for etching considered inadequate.
E—Two or three one sq cm areas were etched on each specimen with "Disa" electropolisher.
F—Specimen No. 5 was rated as having a step structure, but photomicrograph submitted in report shows some ditching.

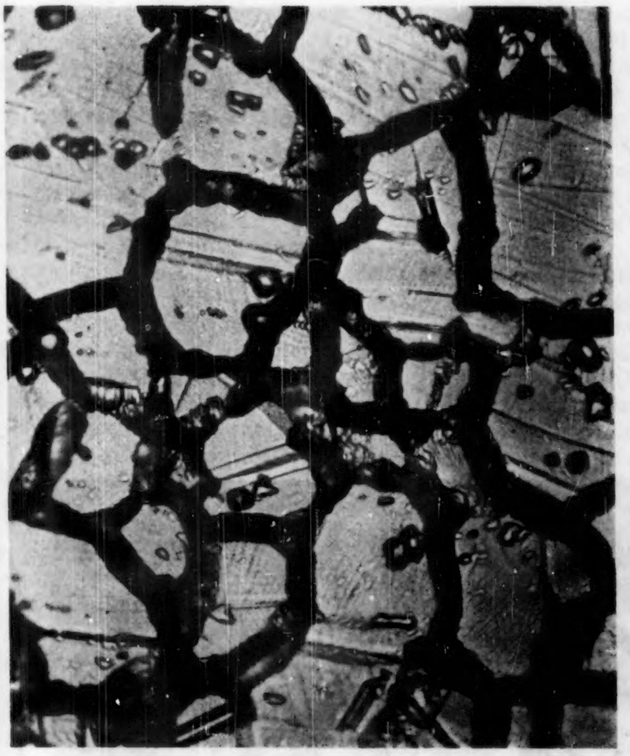


Fig. 2.—Specimen No. 2 AISI Type 304 (× 500)

Fig. 4.—Specimen No. 4 AISI Type 304L (× 250)

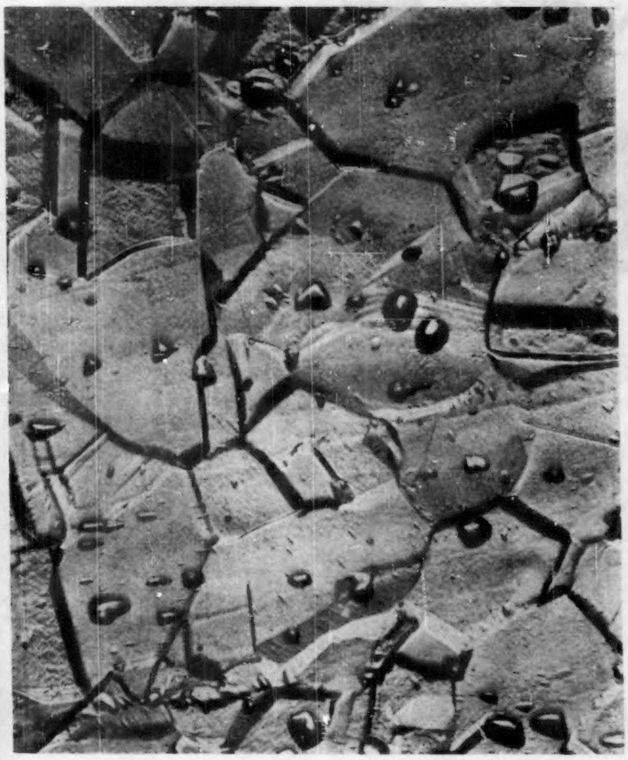


Fig. 1.—Specimen No. 1 AISI Type 304 (× 500)

Fig. 3.—Specimen No. 3 AISI Type 304L (× 250)

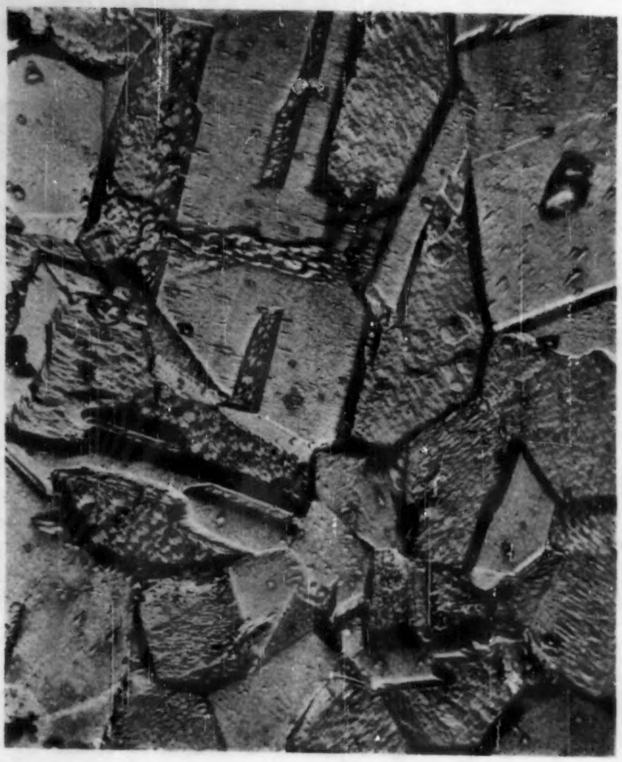


Fig. 6.—Specimen No. 6 AISI Type 316 (× 500)

Fig. 5.—Specimen No. 5 AISI Type 304L (× 250)

Fig. 7.—Specimen No. 7 AISI Type 316 (× 500)

cent (by weight) oxalic acid solution at a current density of 1 amp per sq cm for 1.5 min. Photomicrographs were made of each specimen at a magnification of 250 to 500 ×.

The evaluations of the etch structures were made according to the following criteria:

Step Structure.—Steps only (that is no ditches) at grain boundaries.

Dual Structure.—Some ditching at grain boundaries in addition to steps, but no one grain completely encircled by ditches.

Ditch Structure.—One or more grains completely encircled by ditches.

The participants are in agreement on oxalic acid etch structure evaluations of specimens Nos. 1, 2, and 6 (Table V). For each of the specimens Nos. 4 and 5 there is one "step"-structure evaluation (not counting evaluation of specimen No. 5 by laboratory 16, see note *F*, Table V). Since neither "step" nor "dual"-structure steels require nitric acid testing these two "step"-structure evaluations do not affect the screening result.

On the evaluation of specimen No. 3 there is considerable disagreement on whether it has a dual or a "ditch" structure. In the screening procedure steels having a dual structure do not require testing in nitric acid, while those having a ditch structure do require nitric acid testing. The corresponding 5-period average nitric acid corrosion rates are all considerably less than the 0.0020 in. per month (ipm) maximum permissible rate for this type of steel (average of all 18 laboratories is 0.00098 ipm and the highest value reported is 0.0015 ipm). Therefore, the dual-structure evaluation of this specimen would not lead to the release of a steel having a failing rate.

Specimen No. 7 proved to be nonhomogeneous and was so reported by eleven laboratories (Table V, Note A). Some areas showed dual structure only, while others contained completely encircled grains, that is, ditch structure. Three other laboratories rated this specimen as having ditch structure without further comment. Thus, even though 12 laboratories rated this steel as having ditch structure actually 14 laboratories observed encircled grains. The 5-period average nitric acid rate of 0.00683 ipm (mean value of rates of all participants) is more than four times the maximum permissible rate of 0.0015 ipm for this steel. Therefore, a dual structure evaluation on this specimen would result in the release of material which had a nitric acid rate higher than the maximum permissible rate.

Conclusions

1. All participants agree that specimens Nos. 1, 3, 4, 5, and 6 have passing corrosion rates in the boiling 65 per cent nitric acid test and that specimens Nos. 2 and 7 have failing rates.

2. The screening procedure specifies that steels having a step- or a dual-structure etch do not require submission for nitric acid testing and that those having a ditch structure, that is, one or more grains encircled by ditches, are to be tested in nitric acid. On this basis all participants are agreed that specimens Nos. 1, 4, 5, and 6 do not require nitric acid testing and that specimen No. 2 must be submitted to the nitric acid test. On specimen No. 3 ten laboratories do not require a nitric acid test (dual structure) and the eight others do require the nitric acid test (ditch structure). Since the nitric acid corrosion rate of specimen No. 3 is considerably less than the maximum permissible rate, the dual structure evaluation would not result in the release of a steel having a failing nitric acid rate.

3. The six dual structure evaluations on specimen No. 7 would lead to release of a steel having a failing nitric acid rate. A modification of the originally described oxalic acid etch structure criteria on type 316 steel would appear to be required; that is, on type 316 steel both dual and ditch structures should be submitted for nitric acid testing.

Comments by M. A. Streicher on Behavior of Material Represented by Specimen No. 7

The reasons for the difficulties encountered on specimen No. 7 are associated with the type of intergranular susceptibility observed on type 316L stainless steel described by a number of investigators in the Symposium on Evaluation Tests for Stainless Steels.[4] Sensitized type 316L steel may corrode intergranularly in nitric acid in the absence of intergranularly precipitated chromium carbides. Such a steel may show only step structure in the oxalic acid etch and for this reason the screening[5] test does not apply to type 316L steel. It has been found that the value of 0.03 per cent carbon, which divides type 316 into regular and extra low carbon grades does not produce a sharp change in the relative amounts of the two types of intergranular susceptibilities. Specimen No. 7 has a carbon content of 0.043 per cent and is nonhomogeneous.

In order to guard against the effects of the second type of intergranular susceptibility, it is necessary to limit the acceptance of type 316 steel to those which show step structure only.

The assumption in this procedure is that if a steel has a carbon content of 0.03 per cent or more (that is, if it is a regular grade 316) any exposure to sensitizing temperatures will precipitate some carbides in the grain boundaries, which will produce a dual structure in the oxalic acid etch. The steel should then be submitted for nitric acid testing because of the possibility that some of the second type of intergranular (invisible in the oxalic acid etch structure) susceptibility may also have been formed.

A relatively small number of specimens is affected by this change in evaluation procedure. Type 316 steel samples are not sensitized prior to corrosion testing (as in the case for 304L). As a result a large majority of these specimens (normally 80 to 90 per cent) show step structure only. Moreover, the heats having higher carbon contents which are inadvertently sensitized during processing are likely to show severe ditching, that is, complete encirclement of grains. Thus, the dual structure is relatively rare on these steels.

[4] Issued as separate publication *ASTM STP No. 93* (1949).

[5] These comments refer specifically to the use of the oxalic acid etching technique as a supplement to the nitric acid test for screening purposes. The oxalic acid etch may, of course, be of value for research purposes with any type of stainless steel.

Electrolytic Etching in Oxalic Acid Used to Screen Cast CF-8 and CF-8M Stainless Steels from the 240-Hr Nitric Acid Test

By F. H. Beck,[1] N. D. Greene, Jr.,[1] and M. G. Fontana[1]

A NEW method for determining the susceptibility of some stainless steels to intergranular corrosion is described by M. A. Streicher.[2] He shows that microstructures of stainless steels, as observed under the microscope, will vary according to the degree of sensitization when the steels are etched in oxalic acid under a controlled set of conditions. Characteristic microstructures are observed for steels that are subject to intergranular corrosion, and it is noted that they differ from the microstructures of steels not susceptible to intergranular attack. These characteristic structures are distinct and can be used to screen the good material from the nitric acid test. Streicher shows typical microstructures observed for wrought stainless steels and states that similar structures are observed for cast material.

The present investigation, sponsored by the Alloy Casting Inst. (ACI), shows the microstructures obtained on CF-8 and CF-8M cast stainless steels when the electrolytic oxalic acid etch test is used.

Cast stainless steels of the CF-8 and CF-8M grades[3] electrolytically etched in 10 per cent oxalic acid at a current density of 1 amp per sq cm for 1.5 min show one or more of the following structures:

1. Complete ditching of grain boundaries.
2. Heavy etching of interconnecting ferrite stringers.

TABLE I.—COMPOSITIONS OF TEST CASTINGS.

Steel	ACI Designation	Element, per cent					
		Carbon	Silicon	Manganese	Chromium	Nickel	Molybdenum
A......	CF-8	0.064	0.70	0.47	18.15	9.75	...
B......	CF-8M	0.06	0.82	0.83	19.78	9.2	2.20

TABLE II.—CORROSION RATES IN BOILING 65 PER CENT NITRIC ACID.

Code[a]	Corrosion Rate, ipm[b]						Average Rate, mpy[b]
	First Period	Second Period	Third Period	Fourth Period	Fifth Period	Average	
A-SQ...	0.0009	0.0007	0.0006	0.0007	0.0007	0.0007	8.5
A-S15..	0.0013	0.0016	0.0028	0.0047	0.0069	0.0035	42.0
B-SQ...	0.0009	0.0008	0.0010	0.0008	0.0009	0.0009	11.0
B-S15..	0.0016	0.0027	0.0038	0.0048	0.0058	0.0037	45.0
B-S30..	0.0073	0.304	0.0443	0.0633	0.0708	0.0432	520.0

[a] Code to Heat Treatment:

Code	Heat Treatment	
A-SQ...	CF-8	Solution-quenched in water from 2000 F.
A-S15...	CF-8	Solution-quenched in water from 2000 F and sensitized at 1200 F for 15 min followed by water quench.
B-SQ...	CF-8M	Solution-quenched in water from 2000 F.
B-S15...	CF-8M	Solution-quenched in water from 2000 F and sensitized at 1200 F for 15 min followed by water quench.
B-S30...	CF-8M	Solution-quenched in water from 2000 F and sensitized at 1200 F for 30 min followed by water quench.

[b] Average corrosion rates in inches penetration per month and mils penetration per year. Maximum permissible nitric acid rate for the above two alloy grades is 0.0025 ipm and 30 mpy.

Fig. 1.—Electrolytic Etching Apparatus.

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to ASTM Headquarters, 1916 Race St., Philadelphia 3, Pa.

[1] Professor, Research Fellow, and Assistant Professor, respectively, Corrosion Research Laboratory, The Ohio State University, Columbus, Ohio.

[2] M. A. Streicher, "Screening Stainless Steels from the 240-Hr Nitric Acid Test by Electrolytic Etching in Oxalic Acid," ASTM BULLETIN, No. 188, February, 1953, p. 35 (TP27).

[3] The chemical composition ranges for the CF-8 and CF-8M castings and the corresponding wrought grades for the convenience of comparing data are as follows:

CF-8: 0.08 per cent carbon (maximum), 1.50 per cent manganese (maximum), 0.04 per cent phosphorus (maximum), 0.04 per cent sulfur (maximum), 2.00 per cent silicon (maximum), 18 to 21 per cent chromium, 8 to 11 per cent nickel; corresponding wrought alloy Type 304.

CF-8M: 0.08 per cent carbon (maximum), 1.50 per cent manganese (maximum), 1.50 per cent silicon (maximum), 0.04 per cent phosphorus (maximum), 0.04 per cent sulfur (maximum), 18 to 21 per cent chromium, 9 to 12 per cent nickel, 2.0 to 3.0 per cent molybdenum; corresponding wrought alloy Type 316.

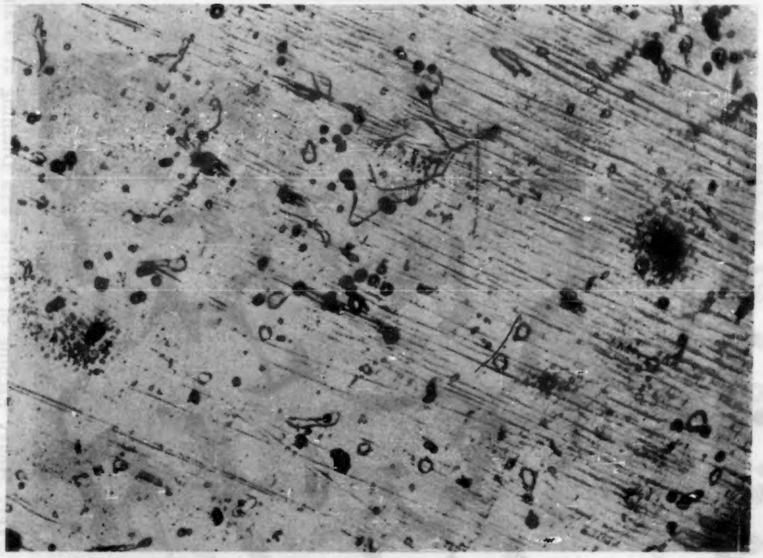


Fig. 2.—CF-8, Code A-SQ—Slight Attack Reveals Ferrite Pools; No Evidence of Grain Boundary Attack. This material passes the oxalic acid etch and the nitric acid test. Nitric acid corrosion rate—0.0007 ipm, 8.5 mpy (× 250).

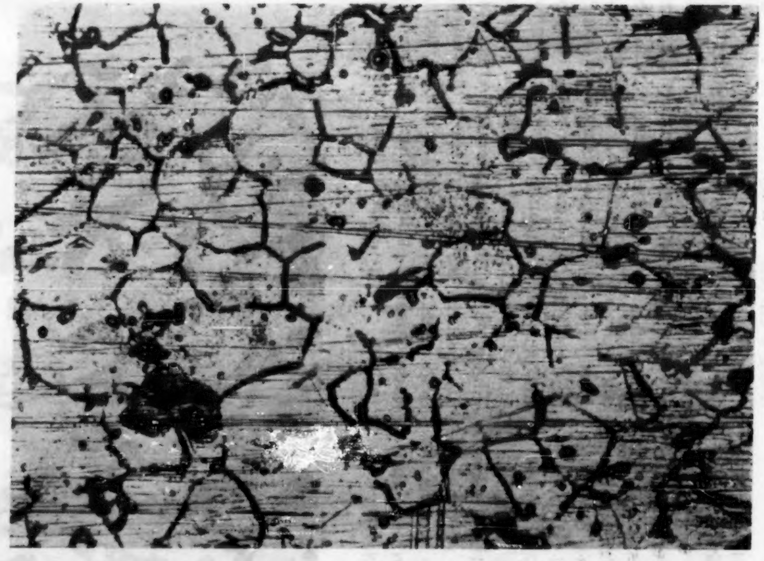


Fig. 3.—CF-8, Code A-S15—Fine Grained Section of Casting Showing Heavy Ditching Which Completely Surrounds Some of the Grains. This material does not pass the oxalic acid etch or nitric acid tests. Nitric acid corrosion rate—0.0035 ipm, 42 mpy (× 250).

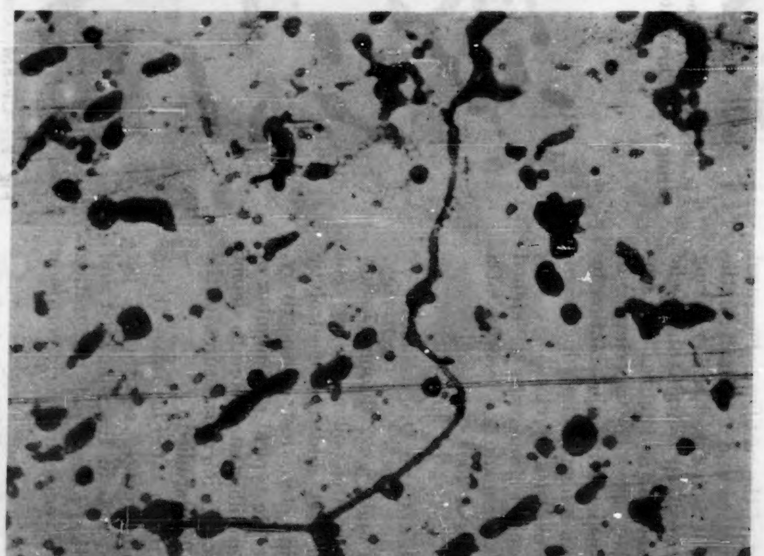


Fig. 4.—CF-8, Code A-S15—Coarse Grain Area of Casting Illustrated in Fig. 3. Ditching of grain boundaries. Material does not pass the oxalic acid etch or nitric acid tests. Nitric acid corrosion rate—0.0035 ipm, 42 mpy (× 250).

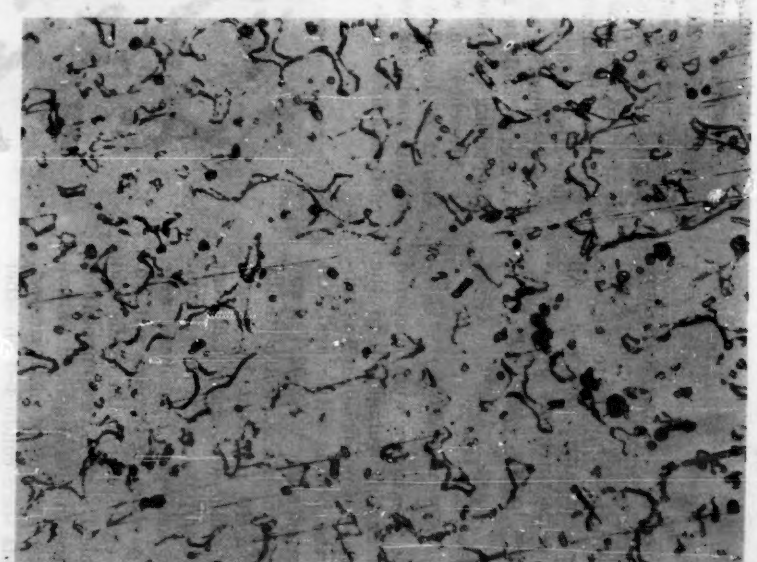


Fig. 5.—CF-8M, Code B-SQ—Slight Attack Reveals Ferrite Stringers; No Evidence of Grain Boundary Attack. This material passes oxalic acid etch and nitric acid tests. Nitric acid corrosion rate—0.0009 ipm, 11 mpy (× 250).

3. Random pitting.
4. Slight etching around ferrite pools.
5. Little or no grain boundary etching.

Only those cast stainless steels showing the structures described under 1 and 2 above should be subjected to the boiling 65 per cent nitric acid test. All other microstructures are representative of steels having acceptable nitric acid rates.

Procedure and Apparatus

Duplicate specimens were prepared from each casting submitted to the screening test. One specimen was subjected to the boiling nitric acid test (ASTM Specification A 262-52 T),[4] and the other specimen was electrolytically etched in a 10 per cent by weight solution of oxalic acid using a current density of 1 amp per sq cm for 1.5 min. The oxalic acid etch specimens were prepared by polishing through grit No. 500 emery cloth prior to the oxalic acid etch. Table I shows the compositions and heat treatments employed on two stainless steels discussed in this report. Similar tests were conducted on other steels of the same types with similar heat treatments.

The apparatus used for electrolytic etching is illustrated in Fig. 1. A 0-135-v, 2-kva autotransformer controls the input voltage to an 18-v, 20-amp, half-wave selenium rectifier. The output of the rectifier is measured by a d-c ammeter and a voltmeter in the circuit. A stainless steel beaker having a capacity of 1.5 qt contains the oxalic acid etch solution and acts as the cathode of the cell. The specimen, or anode, is suspended in the solution by means of an alligator clip which completes the electrical circuit.

Microscopic examinations of etched specimens were made and recorded at a magnification of 250 ×.

Results and Discussion

Table II and Figs. 2 through 7 show the results of the boiling 65 per cent nitric acid test and the electrolytic oxalic acid etch test, respectively. These data are typical of a number of tests and are illustrated here to depict the variations in microstructures for the two cast alloys studied.

The corrosion rates in Table II are reported in inches penetration per month and also in the simplified and more practical form of mils penetration per year. Average nitric acid corrosion rates are also given in the captions to the figures.

Electrolytic etching was performed on specimens using current densities ranging from 0.25 to 2.0 amp per sq cm for times up to 6 min at the lower current densities. Although these tests did indicate that some improvement of the quality of the microstructures on cast materials could be achieved at other current densities and times, no great advantage could be gained by changing the etching conditions from those used by Streicher on wrought materials. Also it is desirable to have standard etching conditions for both wrought and cast stainless steels—that is, electrolytic etching in 10 per cent oxalic acid using a current density of 1 amp per sq cm for 1.5 min.

Figures 2 through 7 are identified by their ACI designation and their heat treatment as described above. Figures 2 and 5 are of solution-quenched CF-8 and CF-8M specimens, respectively. Both of these specimens show low nitric acid rates that are well below the 0.0025 in. per month (ipm) (30 mils per yr (mpy)) maximum permissible rate. These photomicrographs are typical of all castings tested that show low nitric acid rates. In both of the above cases, there is slight etching which reveals the ferrite. There is little or no etching of

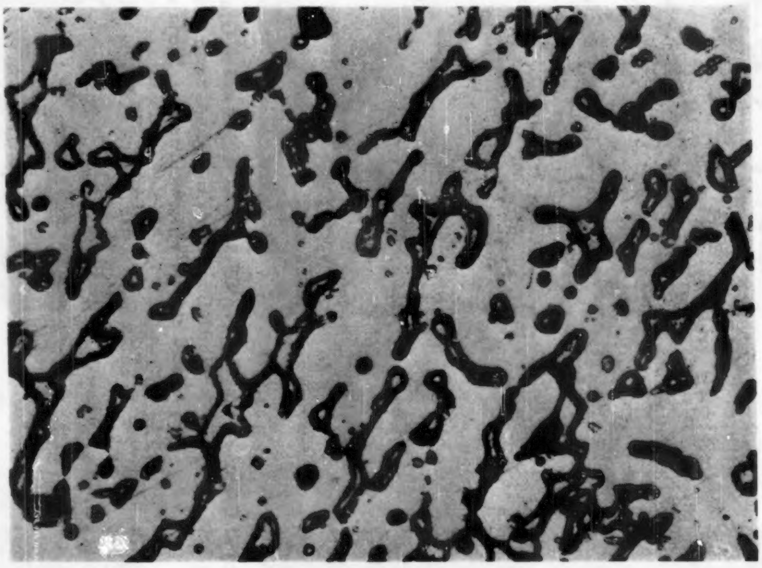


Fig. 6.—CF-8M, Code B-S15—Heavy Etching of Ferrite and Interconnecting Ferrite Stringers. This material fails oxalic acid etch and nitric acid tests. Nitric acid corrosion rate—0.0037 ipm, 45 mpy (× 250).

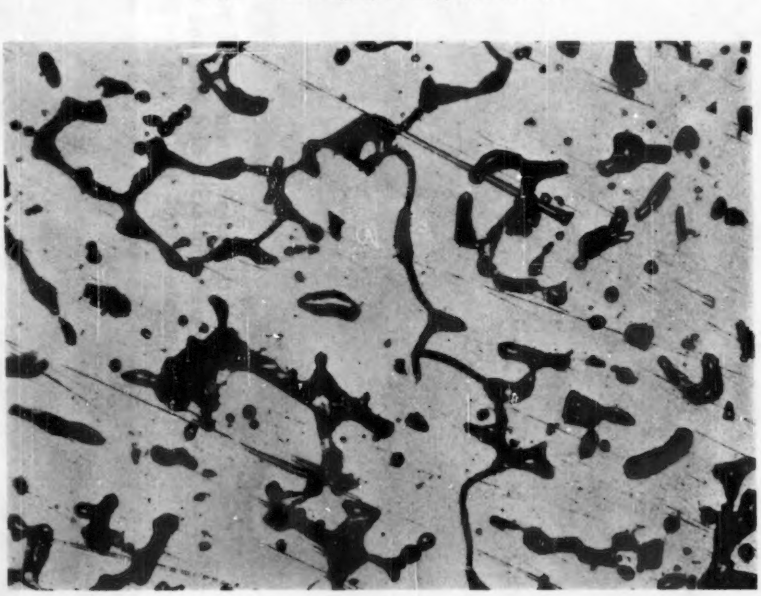


Fig. 7.—CF-8M, Code B-S30—Very Heavy Etching of Ferrite and Ditching at Grain Boundaries. This material fails the oxalic acid etch and nitric acid tests. Nitric acid corrosion rate—0.0432 ipm, 520 mpy (× 250).

[4] Tentative Recommended Practice for Boiling Nitric Acid Test for Corrosion-Resisting Steels (A 262 – 52 T), 1952 Book of ASTM Standards, Part 1, p. 998.

grain boundaries and no evidence of ditching. The main difference between the two structures is the amount of ferrite present. Structures of this type indicate low nitric acid corrosion rates and nonsusceptibility to intergranular corrosion.

Figures 3, 4, 6, and 7 illustrate structures of materials that are subject to intergranular attack. Heavy ditching of grain boundaries is observed in Figs. 3 and 4. The fine-grained structure of Fig. 3 shows some of the grains to be completely ditched. Figure 4 is a large grained area of the same etch specimen illustrated in Fig. 3.

Alloys containing large amounts of ferrite, as shown in Figs. 6 and 7 for the CF-8M composition, can also be screened by the oxalic acid method. The structure in Fig. 6 shows interconnecting stringers of ferrite which are heavily attacked. When such structures are observed, the material should be submitted to the nitric acid test as evidenced by the boiling 65 per cent nitric acid rate obtained for this material. Grain boundary ditching and very heavy attack of the ferrite are observed in Fig. 7. This specimen should be subjected to the nitric acid test on the basis of grain boundary ditching and heavy attack of interconnecting ferrite stringers.

Evidence of pitting is observed in some of the microstructures, but pitting is not considered a determining structure for the screening of cast stainless steels from the nitric acid test.

Screening Cast Stainless Steels by Electrolytic Etching in Oxalic Acid

By G. W. Jackson[1] and W. A. Luce[1]

In a previous paper,[2] M. A. Streicher described a unique method for screening certain stainless steels from the tedious and costly 240-hr boiling 65 per cent nitric acid test (ASTM Specification A 262 - 52 T).[3] The described method consisted of electrolytically etching a polished surface in 10 per cent oxalic acid under controlled conditions and viewing the resultant etched surface under magnification (250 × to 500 ×). The appearance of the etched surface determined whether the sample was free from damaging carbide precipitation at the grain boundaries and needed no further testing (screened) or whether a sufficient degree of grain boundary attack was indicated to warrant further testing in the boiling 65 per cent nitric acid solution. The emphasis in Streicher's introductory article[2] was on several AISI austenitic wrought types, and, although several of the respective cast grades were mentioned, sufficient emphasis was not placed on existing differences between equivalent cast and wrought materials. In addition, no illustrations of typical cast structures were included.

Since it is equally desirous to adapt this rapid screening method to cast stainless alloys where practicable, work was commenced at the laboratories of the Duriron Co., Inc., on the cast compositions. After considerable testing, it can be definitely concluded that the following cast alloys respond to the screening technique: CN-7M,[4] CF-8,[5] and CF-8M[6] (Table I).

TABLE I.—ALLOY CASTING INSTITUTE STANDARD CHEMICAL COMPOSITION RANGES.

	CN-7M	CF-8	CF-8M
Carbon, per cent, maximum	0.07	0.08	0.08
Manganese, per cent, maximum	1.50	1.50	1.50
Silicon, per cent, maximum	1.50	2.00	1.50
Phosphorus, per cent, maximum	0.04	0.04	0.04
Sulfur, per cent, maximum	0.04	0.04	0.04
Chromium, per cent	19–22	18–21	18–21
Nickel, per cent	27.5–30.5	8–11	9–12
Molybdenum, per cent	2.0–3.0	...	2.0–3.0
Copper, per cent, minimum	3.0	...	...

Procedure

The apparatus used for screening the various stainless alloys duplicated that described previously by Streicher, and a detailed discussion is not deemed necessary. Samples were polished through No. 000 emery paper and were made the anode of an electrolytic cell with a 10 per cent oxalic acid electrolyte. A current density of 1 amp per sq cm was maintained for 1.5 min.

Introductory work was accomplished on wrought stainless steels, particularly AISI Types 304 and 316. The test was not difficult to conduct, and the various structures common to the wrought stainless steels after various heat treatments were easily distinguishable. Data from the boiling 65 per cent nitric acid test were obtained from duplicate samples to verify results. Numerous samples of Types 304 and 316 were also examined in the Duriron Co.'s laboratory prior to submitting them to the duPont Co. for their qualification, and in no case did an error result. The variables associated with the test are not so critical as to render it unpredictable. In fact the reverse is true, since the test is easily adaptable to the average laboratory if adequate equipment is available. It is vital that a sufficient current density be applied across each sample. Once it was clearly established that the technique was correct, tests were commenced on the various cast grades. The particular compositions selected were Alloy Casting Inst. (ACI) grades CN-7M, CF-8, and CF-8M.

CN-7M:

This alloy is wholly austenitic in the cast condition and is characterized by its relatively large grain structure. Figure 1 illustrates a typical structure that has been properly solution-quenched (water-quenched after being uniformly heated to approximately 2000 F). Grain boundaries normally appear as a series of small, discontinuous pools or globules

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to ASTM Headquarters, 1916 Race St., Philadelphia 3, Pa.

[1] The Duriron Co., Inc., Dayton, Ohio.

[2] M. A. Streicher, "Screening Stainless Steels from the 240-Hr Nitric Acid Test by Electrolytic Etching in Oxalic Acid," ASTM Bulletin, No. 188, February, 1953, p. 35 (TP27).

[3] Tentative Recommended Practice for Boiling Nitric Acid Test for Corrosion-Resisting Steels (A 262 - 52 T), 1952 Book of ASTM Standards, Part 1, p. 998.

[4] Alloy Casting Institute designation for alloy composition commonly designated by such trade names as Durimet 20, Aloyco 20, Esco 20, FA-20, Shawinigan 20, Utiloy 20, Circle L-34, and others. Produced under Duriron Co. patents.

[5] Alloy Casting Institute designation for 18Cr-8Ni alloy. Cast equivalent of AISI Type 304.

[6] Alloy Casting Institute designation for 18 Cr-8Ni - 2Mo alloy. Cast equivalent of AISI Type 316.

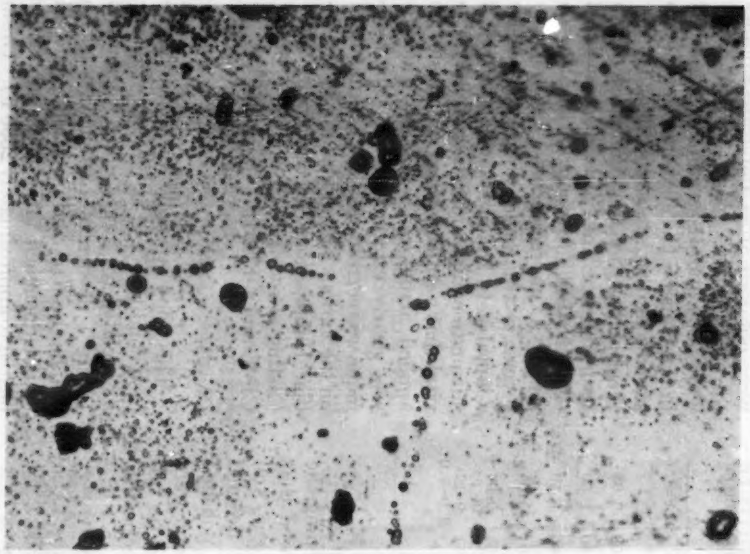


Fig. 1.—CN-7M Heat Solution-Quenched from 2000 F. Note series of discontinuous pools or globules at grain boundaries. Nitric acid rate—0.0010 ipm (× 250).

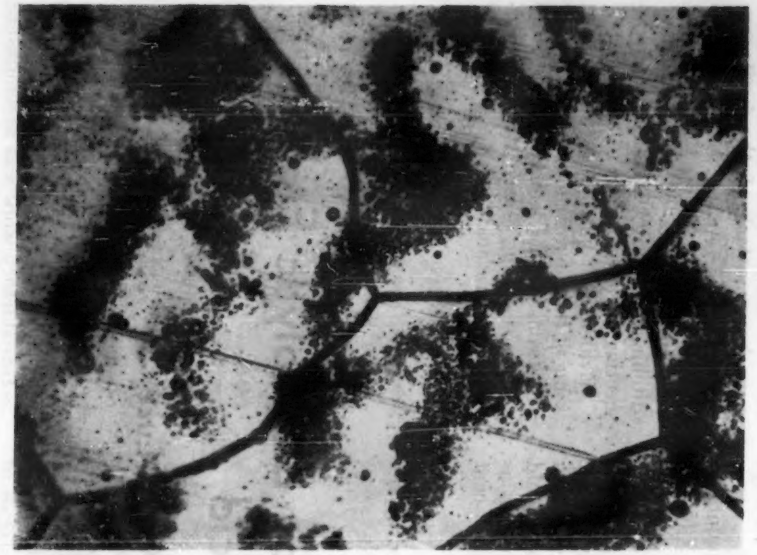


Fig. 2.—Badly Sensitized Specimen of CN-7M with Heavy Continuous Ditching. Must be subjected to nitric acid test. Nitric acid rate—0.0244 ipm (× 250).

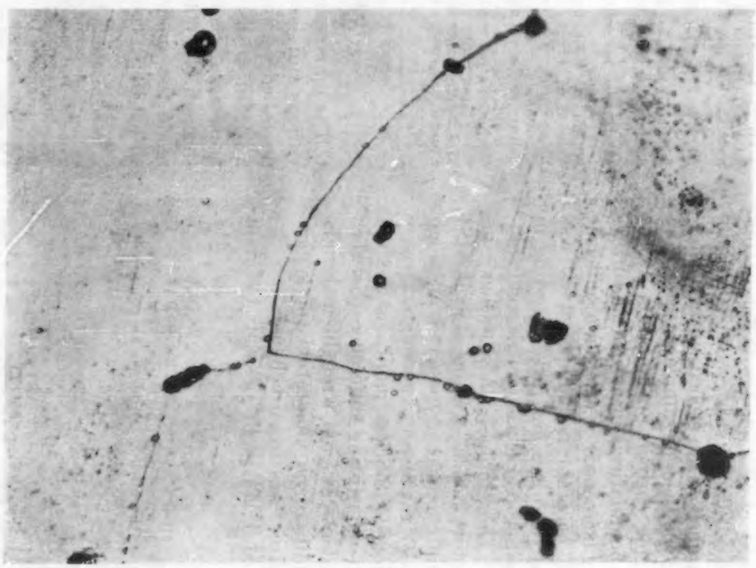


Fig. 3.—Mildly Sensitized Specimen of CN-7M with Continuous Fine Line at Grain Boundaries. Must be subjected to nitric acid test. Nitric acid rate—0.0024 ipm (× 250).

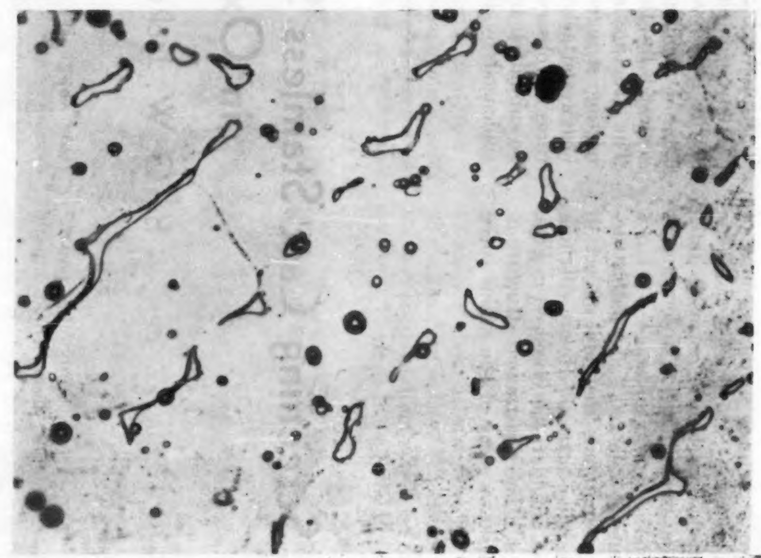


Fig. 4.—CF-8 Heat Solution-Quenched from 2000 F. Ferrite pools show slight attack but no ditching is evident. Nitric acid rate—0.0016 ipm (× 250).

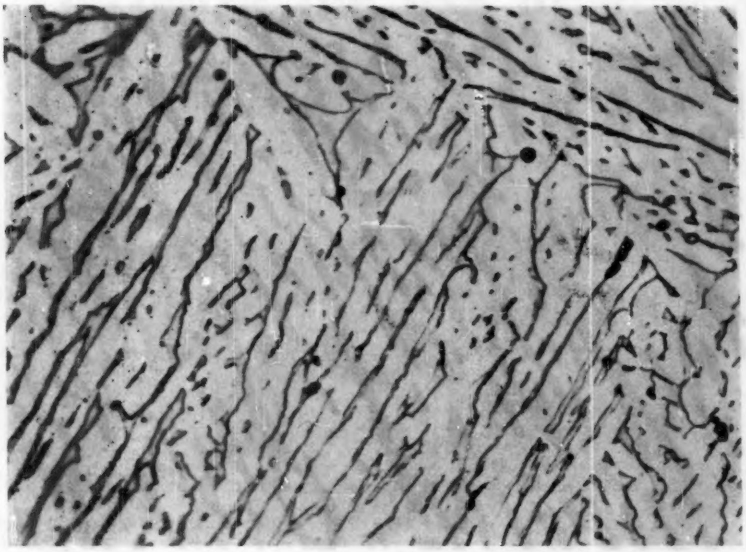


Fig. 5.—CF-8M Heat Solution-Quenched from 2000 F. Ferrite pools show slight attack but no ditching is evident. Nitric acid rate—0.0018 ipm (× 250).

when treated in this manner. Under these conditions the nitric acid rates should be in the order of 0.0008 to 0.0015 in. per month (ipm). Figure 2 illustrates a badly "ditched" structure that will be susceptible to intergranular attack. This sample was heated at 1200 F for 1 hr and is typical of a badly sensitized piece. The corresponding nitric acid test rate was 0.0244 ipm which is much in excess of the 0.0025 ipm maximum set for this alloy. Figure 3 illustrates a mildly sensitized structure that might be considered a borderline material. This condition is distinguished as a continuous fine line normally surrounding the individual grains. Since the accompanying average nitric acid results may vary from slightly below 0.0025 to 0.0035 ipm or possibly greater, this structure would necessitate a standard boiling 65 per cent nitric acid test.

The CN-7M alloy is normally susceptible to a selective attack at small areas within the grains themselves, but this phenomenon should not be considered detrimental. It is suggested that lack of grain boundary ditching be the only criterion for screening CN-7M heats. Any tendency for grain boundary ditching, even if very fine, should require further evaluation.

CF-8 and CF-8M:

Contrary to the CN-7M alloy, the CF-8 and CF-8M grades are not wholly austenitic and normally contain appreciable quantities of ferrite in the structure. The presence of this phase is not deleterious and serves only to complicate the structure slightly. Figure 4 illustrates a properly solution-quenched CF-8 heat that is completely free from grain boundary attack. Slight attack of the ferrite pools may be obtained, but this is characteristic of the alloy. A CF-8M heat (Fig. 5) normally reacts similarly to CF-8 in the solution-quenched condition. The molybdenum-containing CF-8M usually contains an even greater percentage of ferrite. Figures 6 and 7 illustrate typical samples of CF-8 and CF-8M that will not pass the oxalic acid screening test because of heavy etching. These visual results are verified by high nitric acid rates.

Some generalizations can be made based on the tests conducted on the CF-8 and CF-8M compositions. The presence of complete ditching of grain boundaries or heavy etching of interconnecting ferrite stringers necessitate further testing in the standard nitric acid solution. Structures that constitute an acceptable material may show little or no grain boundary attack, mild etching of ferrite pools, and usually some scattered pitting. This pitting appears to be characteristic of all the cast alloys and is of no consequence in the screening operation.

To check the effect of this test on routine heats produced in the Duriron Co.'s foundry, a number of specimens were subjected to the electrolytic oxalic acid test. The specimens were taken from consecutive heats made during recent months. All heats were within the specification limits denoted in Table I. The results of these routine tests are given in Table II. All heats provided structures similar to Figs. 1, 4, and 5 for properly solution-quenched CN-7M, CF-8, and CF-8M, respectively. Spot checking of the samples with the boiling 65 per cent nitric acid test verified the findings. All nitric acid rates were well within the 0.0025 ipm maximum set for these alloys. This illustrates that with proper control the stainless alloys cast under production conditions can be adequately screened by this method.

TABLE II.—RESULTS OF ELECTROLYTIC OXALIC ACID TEST ON ROUTINE HEATS.

Alloy Type	Number of Specimens Tested	Number of Specimens Screened	Percentage Screened
CN-7M.....	50	50	100
CF-8.......	25	25	100
CF-8M......	25	25	100

It was noticed at an early date that the pitting attack predominant with the CN-7M alloy could be greatly minimized by using a lower current density or shorter time than the 1 amp

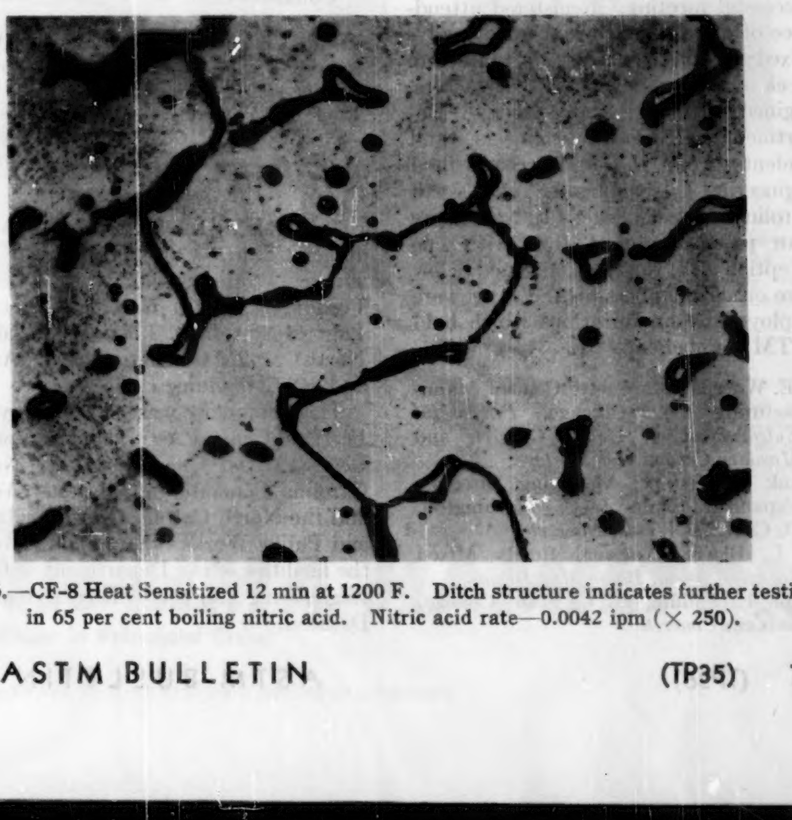


Fig. 6.—CF-8 Heat Sensitized 12 min at 1200 F. Ditch structure indicates further testing in 65 per cent boiling nitric acid. Nitric acid rate—0.0042 ipm (× 250).

per sq cm for 1.5 min suggested by Streicher. A similar advantage was also achieved with the CF-8 and CF-8M alloys, although to a lesser extent. However, when considering the advantage gained by standardizing the test conditions for both cast and wrought compositions, it was decided to accept less perfect structures, particularly since the distinguishing factors are not masked.

Summary

The electrolytic oxalic acid etch is a suitable screening test for the boiling 65 per cent nitric acid test for cast austenitic stainless alloys as well as certain AISI wrought types. ACI cast designations CN-7M, CF-8, and CF-8M can be screened in this manner.

Wrought compositions may exhibit step structures (no grain boundary weakness), ditch structures (susceptible to intergranular attack), or dual structures (combination of step and ditch structures) depending on the prior history of the material. Cast material, when properly solution-quenched, can be recognized only by a lack of ditching since it will rarely exhibit a "step" effect at the grain boundaries. Material requiring further evaluation because of apparent susceptibility to intergranular corrosion will show almost continuous grain boundary ditching. This structure is readily recognizable.

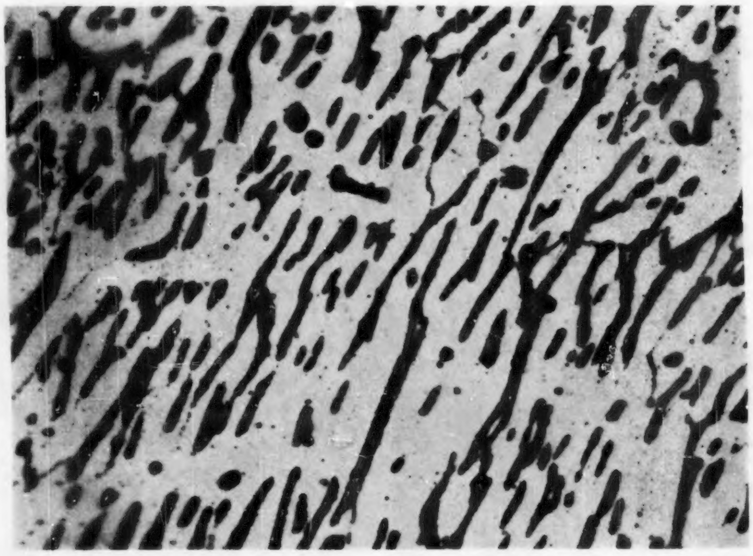


Fig. 7.—CF-8M Heat Sensitized 12 min at 1200 F. Heavy ditching of boundaries and ferrite pools indicate further testing. Nitric acid rate—0.0058 ipm (× 250).

Acknowledgment:

The authors wish to acknowledge the laboratory assistance given by George King.

ASTM Members Prominent in North Carolina State College Concrete Conference

The Second Annual Quality Concrete Conference held November 30 and December 1 at Raleigh, N. C., proved to be a highly successful meeting. Registered attendance of more than 100 included ready-mixed concrete producers, concrete block producers, general contractors, engineers from the State Highway Department, architects, engineers, and students from the architectural and engineering departments of North Carolina State College. It is of more than passing interest that with one exception all of the speakers listed below were either members of ASTM or were employed by organizations which hold ASTM membership.

C. E. Wuerpel, Marquette Cement Manufacturing Co., Chicago, *Purposeful Entrainment of Air in Concrete* and *Masonry Cement and Mortars*.

Frank G. Erskine, Managing Director, Expanded Shale Inst., Washington, D. C., *Light Weight Concrete*.

D. L. Bloem, National Ready Mixed Concrete Assn., *Basic Mix Design*.

Ralph E. Fadum, N. C. State College, *Soils and Concrete*.

Harry McDonald, Penn-Dixie Cement Corp., *Design and Control of Slump Concrete*.

Philip L. Melville, Highway Research, Commonwealth of Virginia, *Research in Concrete*.

D. L. Chaney, Portland Cement Assn., *Construction Practices*, and *Prestressed Concrete*.

Fred F. Van Atta, Special Assistant, ASTM Staff, *Concrete Technology in the Development of ASTM Specifications*.

Presiding at the sessions were W. H. Rogers, North Carolina Highway and Public Works Commission; C. E. Proudley, North Carolina Highway Laboratory, J. B. Linville, President, North Carolina Concrete Masonry Assn., and R. E. Fadum.

The Conference was sponsored by the Portland Cement Assn., North Carolina Ready Mixed Concrete Assn., North Carolina Concrete and Masonry Assn., and the North Carolina State Highway and Public Works Commission through the facilities of the Department of Civil Engineering and the College Extension Division.

Nuclear Data Project

In accordance with provisions of a contract with the Atomic Energy Commission, the National Research Council has established a project on nuclear data. This project has been undertaken upon the recommendation of the Committee on Tables of Constants and Numerical Data, of which A. V. Astin, Director of the National Bureau of Standards, is the chairman. The committee is sponsored jointly by the Division of Chemistry and Chemical Technology and the Division of Physical Sciences.

Work on this type of project was first initiated about six years ago at the Oak Ridge National Laboratory. Later similar work was undertaken on a substantially expanded basis at the National Bureau of Standards. In 1950 the Bureau published *Circular 499* entitled "Nuclear Data." Subsequently additional data have been assembled in preparation for an eventual revision of this Circular. Since Jan. 1, 1952, new nuclear data assembied by the Nuclear Project Group at the Bureau have been published regularly in the Atomic Energy Commission journal, *Nuclear Science Abstracts*.

PERSONALS...

News items concerning the activities of our members will be welcomed for inclusion in this column.

NOTE—*These "Personals" are arranged in order of alphabetical sequence of the names. Frequently two or more members may be referred to in the same note, in which case the first one named is used as a key letter. It is believed that this arrangement will facilitate reference to the news about members.*

At the recent 74th Annual Meeting of The American Society of Mechanical Engineers in New York City the following ASTM members were among five on whom honorary membership was conferred: **Admiral Edward L. Cochrane**, Dean of Engineering, Massachusetts Institute of Technology; and **Sheppard T. Powell**, Consulting Engineer, Baltimore, Md. Admiral Cochrane was cited as a "distinguished naval officer and engineer who, through his leadership, guided naval and marine engineering through a critical period of our history." Mr. Powell, an internationally recognized authority on the treatment of water for sanitary and industrial purposes and the design of industrial waste facilities, was honored "in recognition of meritorious contribution to public health and industrial development . . . controlling and using one of Nature's primary resources—water."

At the annual meeting of the Society of Rheology in late October in New York City officers elected included the following: President—**W. H. Markwood, Jr.**, Hercules Powder Co., Wilmington; Vice-President—**J. H. Dillon**, Textile Research Inst., Princeton, N. J.; and Secretary-Treasurer—**W. R. Willets**, Titanium Pigment Corp., New York City. Dr. Markwood is active in Committee E-1 on Methods of Testing, heading Subcommittee 9 on Rheological Properties. Mr. Dillon participates in activities of Committee D-13 on Textile Materials; and Mr. Willets for several years has been serving as Chairman of Committee D-6 on Paper and Paper Products.

The American Welding Society reelected Fred L. Plummer, Director of Engineering, Hammond Iron Works, Warren, Pa., as its President. As head of this 8000-member technical society, Mr. Plummer will direct its activities for two successive terms. J. J. Chyle, Director of Welding Research, A. O. Smith Corp., Milwaukee, Wis., was elected a Vice-President of AWS; and J. W. Mortimer, of Whitlock Manufacturing Co., Elmwood, Conn., was elected a Director-at-large.

O. E. Anderson for more than 24 years with Westinghouse Electric Corp., Micarta Division, Trafford, Pa., has been appointed to the technical staff of the Continental-Diamond Fibre Co., Newark, Del. A specialist on materials used in electrical insulation, he will function as technical service representative for the company's Silicone, Teflon, and Polyester flexible sheet and tape products. Mr. Anderson has been very active in ASTM Committee D-9 on Electrical Insulating Materials, being a Past-Secretary of that group, and presently serving on the advisory subcommittee, and heading a number of subgroups.

S. B. Ashkinazy has been appointed Department Head for Standards Engineering, Sperry Gyroscope Co., Great Neck, N. Y.

E. W. Bauman, Managing Director, National Slag Assn., Washington, D. C., has been elected President of the Engineers Club of Washington (D. C.). Mr. Bauman has long been active in ASTM technical work, especially in Committees C-9 on Concrete, and D-4 on Road and Paving Materials, and is also very active in the ASTM Washington District Council.

W. E. Buck retired December, 1953, after many years of service as Metallurgical Engineer with the Continental Steel Corp., Kokomo, Ind. Mr. Buck is well known to many ASTM members and committee members, having served on a number of the metals groups for varying periods since 1918, as an individual affiliate and also as a company representative. He may be addressed at 3710 Pine Grove Ave., St. Louis 20, Mo.

A. A. Conrad, Jr., formerly Chief Metallurgist, Precision Metalsmiths, Inc., Cleveland, Ohio, is now associated with the International Nickel Co., Detroit Technical Section, Development & Research Div.

Richard S. Cox is now Dean Emeritus of Philadelphia Textile Inst. A. Ward France has become Dean of Faculty, and Donald B. Partridge has been named Dean of Students.

Ray P. Dinsmore, Vice-President in Charge of Research and Development, Goodyear Tire & Rubber Co., Akron, Ohio, received Certificate of Honorary Membership in the National Council of the American Institute of Chemists, having been named by the Ohio Chapter of AIC for the honor in recognition of his contribution to the advancement of chemistry. He was cited for "inventive genius in rubber chemistry, leadership in research, and helpfulness to his brother chemists."

Albert Willard Dudley, formerly Materials Engineer, Allentown Testing Lab., Inc., Allentown, Pa., is now Resident Engineer, Haverford Township School District Authority, Haverford, Pa.

Bruce B. Farrington, Administrative Assistant to Manager of Petroleum Products Research, California Research Corp., Richmond, Calif., received the National Lubricating Grease Institute's first annual award for outstanding contribution to the lubricating grease industry.

Hugh W. Field, Vice-President of Research and Development, Atlantic Refining Co., Philadelphia, Pa., was awarded the annual (1953) honor scroll of the Pennsylvania Chapter of the American Institute of Chemists.

Paul D. Foote, Vice-President of Gulf Oil and Gulf Refining, and Executive Vice-President and Director of Gulf Research & Development, Pittsburgh, Pa., retired from active executive work December 31.

Albert C. Giesecke recently retired as Hydraulics Engineer, Minnesota Power & Light Co., Duluth, Minn.

J. P. Gill now heads Vanadium-Alloys Steel Co., Latrobe, Pa., which he joined in 1920 as Chief Metallurgist. Mr. Gill, who also is President of Colonial Steel Div. and Vanadium-Alloys Steel Canada, Ltd., was elected Vice-President of the parent firm in 1943, and in 1945 became Chairman of the Executive Committee.

F. R. Grant, formerly Director of Research, Consumers Cooperative Assn., Kansas City, Mo., has accepted a position as Chemical Engineer, Cooperative Farm Chemical Assn., Lawrence, Kans.

Raymond Harsch, Manager of Asphalt Dept., Shell Oil Co., San Francisco, Calif., was elected Chairman of the Executive Committee of The Asphalt Institute.

R. M. Lacy is now Technical Director of Michigan Chrome and Chemical Co., Detroit, Mich. He will be in charge of research and development work on vinyl plastisols and other synthetic coatings for the electroplating, wire goods, textile, automotive, and electrical equipment industries. For the past ten years Dr. Lacy had been Laboratory Manager of General Electric Co.'s Major Appliance Div., Bridgeport, Conn.

William M. Lehmkuhl, formerly associated with The Lehon Co., Wilmington, Ill., has opened Consulting Engineering offices in New York City.

Richard T. Kropf, Vice-President, Industrial Thread Div., Belding Heminway Corticelli Co., Inc., New York City, has been elected to the board of directors of his company. Joining Belding Heminway as Research Engineer in 1931, upon graduation from MIT, he became Director of Laboratories in 1934, Director of Research in 1943, and a Vice-President of the company in 1950. Mr. Kropf is now serving a term on the ASTM Board of Directors.

Guy A. Lindsay, for many years Engineer in Charge, General Engineering, Department of Transport, Ottawa, Canada, has retired.

Robert W. Lowry, formerly with the Capitol Engineering Corp., Dillsburg, has opened Consulting Engineering offices in Mechanicsburg, Pa.

Harvey F. Mack, of Mack Printing Co., Easton, Pa., recently celebrated his 75th birthday and was honored by his associates

(Continued on page 80)

Kodak reports to laboratories on:

how to learn the fundamentals of radiography... a thin photorecording paper... a new way to track down organic chemicals

Radiography

Suppose you desire to find out a little more about the practical aspects of working with x-rays than what you have been able to observe as a medical or dental patient and rank layman. One way to inform yourself painlessly and without nuisance to acquaintances who are professional in the field is through our 100-page book, "The Fundamentals of Radiography." Just issued is the rewritten eighth edition of this work, which has introduced many thousands of practicing x-ray technicians to their careers.

The typical reader the author has in mind is an intelligent and earnest young person who has never previously given much thought to the difference between an anode and a cathode but is willing to learn. Certain of the earlier pages you can probably afford to pass over rather quickly to get to the parts where we review the geometry of x-ray image formation, the effect of kilovoltage on what is shown, scattered radiation and its control, intensifying screens and how to use them, the selection of film and processing procedures, calculation of exposures, how to get more contrast, how to get more detail, how in general to run a radiographic operation for consistently good results and maximum personal safety. The viewpoint is essentially that of the medical x-ray clinic, but the content can be useful elsewhere—to you yourself or to a newcomer you'd like to interest in the topic.

To get a copy of "The Fundamentals of Radiography," one simply drops a note to Eastman Kodak Company, X-ray Division, Rochester 4, N. Y. If, however indirectly, it results in an increment to the ranks of the radiographers, we shall feel amply rewarded.

Linagraph 482

Our trade-mark "Linagraph" is applied to certain of our photographic papers and films which do their bit for progress by delivering crisp, black-line oscillograph traces on clean backgrounds. Time was when we beat the drum heavily for the versatility and virtually unlimited frequency response of photographic oscillography and the desirability of keeping consistent oscillographic records for future engineering reference. Then we came to realize that we were belaboring the obvious. The various oscillographs on the market are able to speak very creditably for themselves. We'll concentrate on continuing to squeeze improvements out of the photographic paper and film for them.

In pursuance of this policy, we now draw to your attention the new *Kodak Linagraph 482 Paper*, which has an extra thin, yet exceedingly durable paper base that makes it easier to get the best photocopies of your recordings and any pen or pencil notations they may have acquired. Furthermore, the crispness and blackness of the traces and the whiteness of the background are nowise dependent on cooling the processing solutions. Any temperature below 120 F will do.

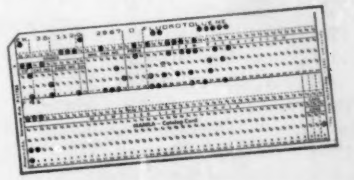
The new paper is available from most oscillograph manufacturers and from all Kodak Industrial Dealers in many widths and spoolings. If you'd like information on how to make photocopies from it, write Eastman Kodak Company, Industrial Photographic Division, Rochester 4, N. Y.

Fine needles, fine haystack

o-Benzoic Sulfimide (Eastman 38) is a white powder melting at 224-226 C and slightly soluble in water, chloroform, alcohol, and ether. The compound is of importance in commerce as "insoluble saccharine."

2-Aminobenzothiazole (Eastman 3940) is nearly white crystals, melting at 129-131 C, slightly soluble in water, quite soluble in chloroform, alcohol, and ether. It is used as an intermediate in the manufacture of certain photographic chemicals.

One of our senior chemists, who knows the Eastman catalog about as well as he knows his children's names and ages, got to brooding recently that given one of these compounds, even *he* wouldn't have been able to name the other right off as one of its nearest relatives in our list. (Both consist of a C_3NS heterocycle fused to a carbocycle.) His unease about the difficulty in picking up such relationships among his own merchandise pricked him to spend a good many hours at home making up a deck of cards coded for each compound, that could be shuffled in various ways.



We now learn that another chemist, who works not for us but for Remington Rand, has done the job by punched cards. We ourselves have encoded a fair amount of chemical data on punched cards, but this chemist has done it by the new Wiswesser notation for every Eastman Organic Chemical having a known structure. Thus electromechanical brains, such as are ensconced in many large organizations, can fill in their idle moments by discovering all sorts of important relationships among the more than 3500 organic compounds available from a single, completely dependable source—namely, us.

If you want to know more about what this man has done, or if you want to purchase our catalog in punched-card form, write Remington Rand Inc., 315 Fourth Avenue, New York 10, N. Y. In its conventional book form, the catalog remains free of charge. If you need a copy, write to Distillation Products Industries, Eastman Organic Chemicals Department, Rochester 3, N. Y. (Division of Eastman Kodak Company).

DPi

This is one of a series of reports on the many products and services with which the Eastman Kodak Company and its divisions are . . . *serving laboratories everywhere*

Kodak
TRADE-MARK

(*Continued from page 78*)

at the company. A special issue of *eM-PiCa*, the company house organ, featured his life story with pictures. The Mack Co. has been printing the ASTM BULLETIN for many years.

William H. Mills, formerly District Engineer for The Asphalt Institute, Atlanta, Ga., left on December 1 for Rio de Janeiro, Brazil, on a two-year assignment as consultant to the Departmento do Estradas e' Rogardems, State of Espirito Santo. For the past four years Mr. Mills had served with The Asphalt Institute, and for twenty years he was with the South Carolina State Highway Department. During World War II he was stationed in Brazil for almost three years, serving in the Corps of Engineers of the U. S. Army.

M. R. Neumann, formerly Chief Engineer, Hersey Inspection Bureau, Oakland, Calif., is now with Woodward, Clyde & Associates, of the same city.

Charles Hunt Ow, for many years Specification Supervisor, United States Steel Corp., Munhall, Pa., has retired.

W. L. Pinner has been appointed Manager of the Process Development Div., Houdaille-Hershey Corp., Detroit, Mich. He will head up a unit of the Corporation which coordinates technical control of its manufacturing operations with process development in metallurgical, electrochemical, painting, and other fabrication activities.

F. D. Rossini, Head of Chemistry Dept., Carnegie Institute of Technology, Pittsburgh, Pa., has been elected Chairman of the Division of Petroleum Chemistry of the American Chemical Society.

A. O. Schaefer, Vice-President in Charge of Engineering and Manufacturing, The Midvale Co., Philadelphia, Pa., and a member of the ASTM Board of Directors, has received an Award of Merit from the University of Pennsylvania, in recognition of outstanding service to the engineering profession and to the University where he has served on the editorial board and advisory committee for chemistry, and as an active member and recent President of the Engineering Alumni Society.

Harry A. Schwartz, for many years Manager of Research, National Malleable and Steel Castings Co., Cleveland, Ohio, retired recently from full-time work. His services are available to the company, however, in a newly created position of Assistant to the Vice-President in Charge of Production.

Ellsworth M. Smith, formerly Chief Metallurgist, Beryllium Corp., has been named Vice-President and Chief Metallurgist of Penn Precision Products, Inc., Reading, Pa.

G. F. Smith, Chemistry Department, University of Illinois, has been elected Chairman of the Division of Analytical Chemistry of the American Chemical Society.

Foster Dee Snell, head of Foster D. Snell, Inc., New York City, was reelected President of the Association of Consulting Chemists and Chemical Engineers.

John E. Viscardi is now Senior Engineer, Nuclear Development Associated, Inc., White Plains, N. Y.

A. S. Wall, for many years associated with the Dominion Bridge Co., Ltd., Montreal, Canada, as Plate and Boiler Engineer, and more recently as Engineering Consultant, has retired. A. M. Bain succeeds Mr. Wall as Plate and Boiler Engineer, also as representative of the company's Sustaining Membership in ASTM. Dominion Bridge is one of the Society's 1954 Fifty-Year Members.

H. E. Wiedemann, Consulting Engineer, St. Louis, Mo., and long-time ASTM member, active in technical committee work and the St. Louis District Council, was granted the honorary degree of D.P.Y. (Doctor of Perpetual Youth) by his fraternity brothers of the St. Louis Professional Chapter of Alpha Chi Sigma, at a special meeting and banquet in late November, celebrating the fiftieth anniversary of his start in the chemical profession.

W. Clifford Witham, formerly with the Sun Oil Co., Marcus Hook, Pa., Development Div., is now with the Armour Research Foundation, Department of Chemistry and Chemical Engineering, Chicago, Ill.

NEW MEMBERS...

The following 33 members were elected from November 13, 1953, to January 1, 1954, making the total membership 7600 . . . Welcome to ASTM

Note—Names are arranged alphabetically—company members first then individuals

CHICAGO DISTRICT

Gibson, William D., Co., The, Div., Associated Spring Corp., Otto R. Hills, Chief Engineer, 1800 Clybourn Ave., Chicago 14, Ill.

Minnesota Power and Light Co., Spencer Ure, Civil Engineer, 30 W. Superior St., Duluth 3, Minn.

Land, George W., Industrial Consultant, Peabody Coal Co., 231 S. LaSalle St., Chicago 4, Ill.

CLEVELAND DISTRICT

Erndt, Edmund E., Vice-President, Pre-Vest, Inc., 23420 Lakeland Blvd., Cleveland 23, Ohio.

NEW ENGLAND DISTRICT

National Research Corp., Frank C. Benner, Assistant Director, Chemical Dept., 70 Memorial Dr., Cambridge Mass.

NEW YORK DISTRICT

Stroock and Co., Inc., S., Herbert C. Haller, Head, Materials Engineering Dept., Box 706, Newburgh, N. Y.

Wu, Alfred C., Representative, Wah Chang Corp., 63 Herbhill Rd., Glen Cove, N. Y.

PHILADELPHIA DISTRICT

Reynolds, Samuel D., Jr., Metallurgical Engineer, Westinghouse Electric Corp., Steam Div., Lester, Pa. For mail: 6 Benjamin West Ave., Swarthmore, Pa. [J], *

Samans, Walter, Registered Professional Engineer-Consultant, Room 807, 1616 Walnut St., Philadelphia 3, Pa.

PITTSBURGH DISTRICT

Firth Sterling, Inc., D. F. Dickey, Manager, Research and Development, 3113 Forbes St., Pittsburgh 30, Pa.

Davis, Evan A., Research Engineer, Westinghouse Research Labs., Westinghouse Electric Corp., East Pittsburgh, Pa.

Hipple, John A., Director, Mineral Industries, Experiment Station, The Pennsylvania State University, State College, Pa.

NORTHERN CALIFORNIA DISTRICT

Dunn, Alfred, Head, Materials Testing, Pioneer Rubber Mills, Box 791, Pittsburg, Calif.

Fisher, Charles E., Quality Control Manager, Norris-Thermador Corp., Box 1123, Modesto, Calif.

Grant, Eugene L., Professor of Economics of Engineering, Department of Civil Engineering, Stanford University, Stanford, Calif.

Polivka, Milos, Engineer, Materials Laboratory, University of California, Berkeley 4, Calif.

ST. LOUIS DISTRICT

Glick, A. E., Chief Engineer, Broderick & Bascom Rope Co., 4203 N. Union Blvd., St. Louis 15, Mo.

Siegel, Allan M., Director, Industrial Research and Testing Labs., 1919 Chouteau Ave., St. Louis 3, Mo.

Whitney, F. L., Jr., Corrosion Consultant, Monsanto Chemical Co., 1700 S. Second St., St. Louis 4, Mo.

SOUTHERN CALIFORNIA DISTRICT

Hess, John D., Research Director, Valley Analytical and Testing Laboratories, Inc., Box 642, El Centro, Calif.

Kreck, W. F., President, Southern Bolt and Screw Co., 4807 S. Boyle Ave., Los Angeles 58, Calif.

Tarr, Phillip V., Chief Engineer, Kwikset Powdered Metal Products, 517 E. Santa Ana, Anaheim, Calif.

WASHINGTON (D. C.) DISTRICT

Western Electric Co., Inc., P. A. Moody, Chief, Chemical and Metallurgical Engineering Dept., Chatham Rd., Winston-Salem, N. C.

Outterson, Charles R., Director of Research, Albermarle Paper Manufacturing Co., Richmond, Va. For mail: River Rd., Box 105, Richmond, Va.

WESTERN NEW YORK-ONTARIO DISTRICT

Penn Extrusion Corp., J. H. Rector, Product Supervisor, Twentieth St. and Powell Ave., Erie, Pa.

UNITED STATES AND POSSESSIONS

Crowley, Barbara A., Librarian, Shell Development Co., Agricultural Research Div., Box 2171, Denver 1, Colo.

Rasmussen, Carl A., Director of Research, Western Pine Assn., 7733 S. E. Thirteenth Ave., Portland 2, Ore.

OTHER THAN U. S. POSSESSIONS

Bateman, L. C., Director of Research, The British Rubber Producers' Research Assn., 48/52 Tewin Rd., Welwyn Garden City, Herts, England.

* J denotes Junior Member.

(*Continued on page 82*)

(Continued from page 80)

Bresolin, L. F., Engineer, Cities Service Oil Co., Ltd., 4 Carlaw Ave., Toronto, Ont., Canada.

Rizzo, Frank, President and General Manager, International Inspection and Testing Corp., Central P. O. Box 601, Tokyo, Japan.

Smith, W. J., Head, Timber Mechanics Section, Forest Products Laboratory, Forestry Branch, Federal Department of Resources and Development, University of British Columbia, Vancouver 8, B. C., Canada.

Webb, Thomas B., Chief Research Engineer, Babcock & Wilcox, Ltd., Babcock House, Farringdon St., London E.C. 4, England.

Zeitlen, Joseph G., Soil Mechanics Expert, Assistance Administration, United Nations, N. Y. For mail: United Nations, c/o Israel Institute of Technology, Haifa, Israel.

NEWS NOTES ON

Laboratory Supplies and Testing Equipment

Please mention ASTM BULLETIN when writing to suppliers

CATALOGS AND LITERATURE

Cement Tester—Bulletin 4205, issued by Baldwin-Lima-Hamilton Corp., presents in illustrated form a 50,000 lb cement tester. Its four pages cover the evolution of the new machine with development of ASTM Test Method C 109,[1] and give features and specifications of the machine.

Baldwin-Lima-Hamilton Corp., Philadelphia 42, Pa.

Precision Balances—Bulletin 329, recently published by Burrell Corp., describes and illustrates a complete line of chemical and non chemical balances. Burrell has been appointed exclusive distributor in the United States for English-made Stanton balances. Built by Stanton Instruments, Ltd., London, the precision balances are used principally in laboratory weighings.

Burrell Corp., 2223 Fifth Ave., Pittsburgh 19, Pa.

Non-Destructive Testing Instruments—An eight-page bulletin, now available from J. W. Dice Co., illustrates and describes nondestructive testing instruments. Bulletin 32 indicates some industries in which these instruments are applicable: metal working; automotive; aircraft; food; paper; plastics; and other fields. The company can supply a wide variety of additional machines and devices for physical testing and measuring of metals and other materials.

J. W. Dice Co., Englewood, N. J.

Precision Instruments—A new engineering bulletin, recently issued by W. C. Dillon & Co., Inc., contains illustrations and descriptions of the following equipment: Model L universal testers; traction dynamometers; overload signals and switches; motorized multi-low range universal tester; mechanical pressure gage; weight indicator; and stainless steel thermometers. Copies of Bulletin 19E available on request.

W. C. Dillon & Co., Inc., 14620 J Keswick St., Van Nuys, Calif.

[1] Standard Method of Test for Compressive Strength of Hydraulic Cement Mortars (C 109 – 52), 1952 Book of ASTM Standards, Part 3, p. 119.

Specialized Instruments—An illustrated four-page bulletin has been published by F. W. Dwyer Mfg. Co. featuring a broad line of specialized instruments and gages. Included are instruments for accurate measurement of combustion, draft, pressure, flow, vacuum, CO_2, smoke, velocity, static pressure, pressure differential, temperature, and other similar studies.

F. W. Dwyer Mfg. Co., 317 S. Western Ave., Chicago 12, Ill.

Laboratory Instrumentation—Just off the press is the newest number of *The Laboratory*, Vol. 23, No. 2, published by Fisher Scientific Co. for those interested in "the latest developments in laboratory instrumentation and technique." Feature article is "Cigarettes: There's More to Them Than Smoke," the first comprehensive news report on the research behind the multi-billion dollar industry. One new instrument is described as the world's first single-pan, constant-load, automatic micro balance cutting 5-min micro weighings to 35 sec. Among the new apparatus announced is a mechanical laboratory glassware washer designed to handle even oversized and odd-shaped glassware (as well as micro pipets). Copies free on request.

Fisher Scientific Co., 717 Forbes St., Pittsburgh 19, Pa.

Petroleum Testing Apparatus—An illustrated six-page bulletin available from The Emil Greiner Co. features petroleum testing instruments. Equipment described in this issue includes: improved cover for Pensky Martens; constant temperature bath for use in testing API and specific gravity of petroleum products; LPG vapor pressure bomb; turbine oil rust prevention apparatus; MacCoull corrosion tester; twin unit apparatus for tetraethyllead in gasoline; turbine oil oxidation bath; and high-temperature Saybolt viscosimeter. Request "labitems," Vol. 3.

The Emil Greiner Co., 20-26 N. Moore St., New York 13, N. Y.

Unit Measuring System—Instrumentation Data Sheet No. 10.0-14 recently published by Minneapolis-Honeywell Regulator Co. contains information on the new Electronik high-impedance input instrument. As source impedance changes from 0 to 50,000 ohms, instrument sensitivity, speed, and damping are not seriously impaired. It is stated that the instrument meets the high fixed or variable source impedance specifications of most industrial and laboratory applications.

Minneapolis-Honeywell Regulator Co., Industrial Div., Philadelphia 44, Pa.

Instrumentation—A new 48-page issue of "Instrumentation," Vol. 7, No. 1, contains 16 articles dealing with measurement and control. Also included are sections on new products and new literature.

Minneapolis-Honeywell Regulator Co., Industrial Div., Philadelphia 44, Pa.

Radio Compass Control Panel—A new bulletin giving technical information on the miniaturized radio compass control panel is available from the Electronics Div., North American Philips Co., Inc. Dimension drawings and circuit diagrams are included for the ED-100 and ED-200 models which provide for complete control of a receiver ARN-6 from a remote location by electrical or mechanical coupling.

North American Philips Co., Inc., Research & Control Instruments Div., Mount Vernon, N. Y.

Recording Equipment—A new eight-page issue of *Right Angle*, Vol. 1, No. 2, published by the Industrial Div. of Sanborn Co. features an article entitled "Factors Affecting Accuracy of Oscillographic Records." Other articles deal with four-channel recording systems; and performance of a modified Model 67 system. Additional information from the company.

Sanborn Co., Industrial Div., Cambridge 39, Mass.

Laboratory Equipment—A new 24-page edition of *What's New for the Laboratory*, 19th in the series, has been announced by the Scientific Glass Apparatus Co., Inc. Featured items include a new line of heating mantles with aluminum housings; two new ovens; a sterile fluid pump; "Pyrex" glass fraction cutter; chromatography equipment; ultraviolet lamps; Coors porcelainware; automatic glassware washer; AO Rapid-Scanning Spectro-

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glass jar bath; plus many others. For free copy write directly to the company.
Scientific Glass Apparatus Co., Inc., Bloomfield, N. J.

What Is Hard Water—A new book dealing with the practical aspects of different classes of water supply has been announced by Foster D. Snell, Inc. Compiled and authored by Cornelia A. Tyler of the Snell staff, this book shows how the condition of water can be controlled to make everyday living more pleasant and less costly. The book includes graphic explanations of why hard water is "hard," results of soap tests, review of effects on cooking and human consumption, and the conveniences in soft water usage. Ion-exchange and municipal hardness reduction are reviewed.
Foster D. Snell, Inc., 29 W. 15th St., New York 11, N. Y.

INSTRUMENT NOTES

Nuclear Spectrometer—It now is possible to analyze minute samples of substances ranging from chemicals to metallic alloys with an instrument developed at Armour Research Foundation. The instrument, called a nuclear spectrometer, is used to detect and measure materials in amounts far below the limits of other methods. With its ability to discriminate between radiations of different energies and kinds (alpha, beta, gamma, or x-rays), it can be used to detect and analyze many elements in various states of composition.
Armour Research Foundation, Technology Center, Chicago 16, Ill.

New Instrument for Continuous Indication, Recording and Control of Viscosity—An industrial instrument which provides accurate and continuous viscosity measurement of materials in process, is now available from Brookfield Engineering Labs. Known as the Viscometran, it provides a method of supplying continuous measurement, recording, and control of viscosity. The instrument may be used for applications involving base mount temperatures up to 200 F and in a vacuum from 8 mm of mercury to pressures of 100 psi. Complete information available on request by contacting the Technical Applications Section.
Brookfield Engineering Labs., Inc., 240 Cushing St., Stoughton, Mass.

Motor Drive—A new mechanical tracing accessory for use with the Surfindicator, an instrument which measures surface roughness, has recently been announced by the Brush Electronics Co. Motor Drive, Model BL-114, provides mechanical movement of the Surfindicator pickup along a surface being inspected. It is designed for special applications which extend the usefulness of the basic Surfindicator beyond the range that is practical with hand operation. Instantaneous reversal, constant speed, and low vibration level of the unit insure surface roughness measurements of the highest possible accuracy. For detailed description, write Equipment Div. SP.
Brush Electronics Co., 3405 Perkins Ave., Cleveland 14, Ohio.

Instrument Air Valve—A new line of small instrument air valves has recently been added by Crawford Fitting Co. Manufactured by Hoke, Inc., Englewood, N. J., they are equipped with Crawford Swagelok ends to provide leakproof and torque-free seals on every type of instrumentation installation. Additional information can be obtained from the company.
Crawford Fitting Co., 884 E. 140th St., Cleveland 10, Ohio.

Micro Gram-atic Balance—A 20-gram-capacity microbalance now available from the Fisher Scientific Co. features high accuracy (±0.002 mg) and high speed (5- to 8-min carbon and hydrogen weighings completed in 35 sec). The new balance should expedite microlaboratory control.
Fisher Scientific Co., 717 Forbes St., Pittsburgh 19, Pa.

New Air Permeability Apparatus—A machine to measure fabrics at pressure

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differentials has been constructed by Sherman W. Frazier. Designed to meet the demand for testing the air permeability of fabrics at pressure differentials up to 20 in. of water, it is a modification of the air permeability machine for fabrics manufactured by Frazier.

Sherman W. Frazier, 953 15th St., S. E., Washington 3, D. C.

Interference Tester—William J. Hacker & Co. announces a new Interference Tester, developed by Reichert, that has many advantages over the Interference Microscope. The Reichert Interference Tester can be used with almost any inverted microscope and it permits the detection of roughness to meet the most exacting demands. The range of this equipment covers depths of roughness from approximately 1 to 0.015 micron. Complete information available on request.

William J. Hacker & Co., Inc., 82 Beaver St., New York 5, N. Y.

Testing Machine for the Rubber Industry—A line of twelve different types of apparatus for the physical testing of rubber and other elastic materials is offered for the first time by William J. Hacker & Co. There is a suitable machine for every phase of operation in testing rubber. The equipment includes: Resilience Testers; Rubber Hardness Testers; Tensile Testing Machines for Rubber; Foam Rubber Testing Machines; and Abrasion Testing Machines. The equipment permits tests to conform to standard ASTM specifications. Further information can be obtained from the company.

William J. Hacker & Co., Inc., 82 Beaver St., New York 5, N. Y.

New High-Impedance Instrument—An instrument especially designed for use with high-impedance detecting devices has been developed by the Industrial Div. of Minneapolis-Honeywell Regulator Co. Incorporating a new input circuit the instrument will provide a wide d-c application potential. It may be used for small current measurement with fixed source impedance, millivoltage measurement with variable source impedance and high impedance d-c bridges.

Minneapolis-Honeywell Regulator Co., Industrial Div., Philadelphia 44, Pa.

Apparatus for Gaseous Carbon-14 Assay—Apparatus is now available from the Nuclear Instrument and Chemical Corp. for the assay of radioactive carbon-14 by the Van Slyke-Steel procedure. This method has several advantages over that of counting solid barium carbonate samples: (1) for a given sample size, measurements of lower specific activities are possible; (2) over-all sensitivity is greater since counting losses due to window, air, or self-absorption are avoided. Full information may be obtained from the manufacturer.

Nuclear Instrument and Chemical Corp., 229 W. Erie St., Chicago 10, Ill.

Sheet Metal Hardness Tester—A new precision type sheet metal hardness tester, Model 317, has recently been announced by The Pacific Transducer Corp. This instrument offers a more precise method of testing the hardness of all types of sheet metal, both ferrous and non-ferrous. By use of a calibrated microscope and reticle, readings can be obtained well within two points in the Brinell scale. The tester is designed for use in warehouses, factories, metallurgical laboratories, and wherever it is necessary to know the hardness of sheet metals. Sheet stock of from 0.010 to 0.250 in. may be measured.

The Pacific Transducer Corp., 11921 W. Pico Blvd., Los Angeles 64, Calif.

Equipment for Evaporation of Liquids—A new piece of equipment used for the evaporation of liquids in laboratory work has recently been developed by the Quartz Products Corp. Known as the Epiradiator, it subjects the surface of the liquid to calorific radiation. Units come in four sizes for operation on 110 or 220 volts.

Quartz Products Corp., 25 Crowsmill Rd., Keasbey, N. J.

Scintillometer—A new Model 963 scintillometer has been developed by The Radiac Co., Inc. It is used for making production checks in radioactive ore processing and for field and laboratory radioactive ore assaying. It detects and measures gamma radiation within wide limits under extended ranges of temperature and humidity. Literature available upon request.

The Radiac Co., Inc., 489 Fifth Ave., New York 17, N. Y.

Indicating Thread Gages—A new line of indicating thread gages has been an-

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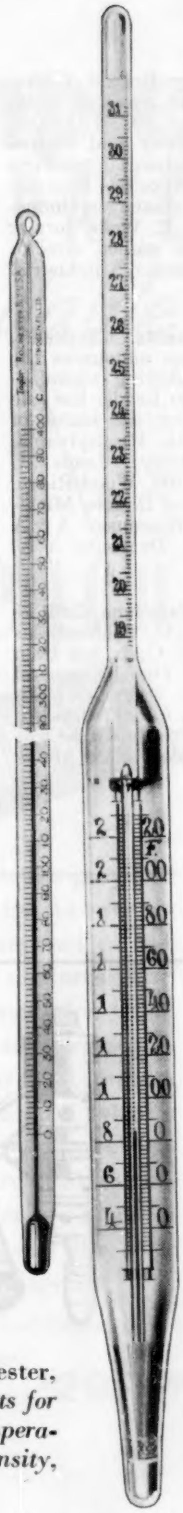
THE NAME TAYLOR IS YOUR PROTECTION

on etched stem thermometers & hydrometers



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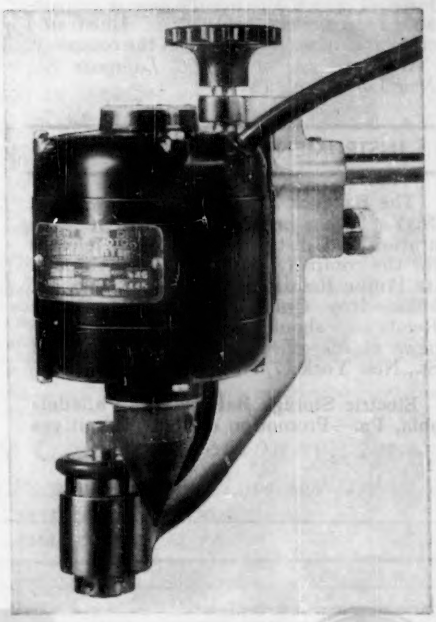

Many thousands of these Sargent stirring motors featuring a drive principle designed by E. H. Sargent & Co., are regularly employed throughout the world.

The chuck shaft is driven from a constant speed motor through a cone-to-ring device permitting continuous adjustment of speeds from 200 to 1200 r.p.m., and transmitting full motor power at all speeds. Speed adjustment is accomplished by turning a hand wheel which determines the diameter of the cone in contact with the driven ring.

The Sargent cone drive motor delivers the full work capacity of the motor at the chuck or pulley and so combines ample power with convenient motor size. Where other types of stirring devices either have a very limited range of speed or resort to the use of power dissipating rheostats, stalling loads such as brakes or governors, or to friction drive through normal plates causing a cross drag, all of which dissipate motor power, the Sargent cone drive stirring motor assures continuous adjustment of speed without sacrifice of full power transmission, even in the useful low range of 200 to 600 r.p.m.

The motor is silent, safe in laboratory atmospheres and constant in speed, and is of the highest quality, with life-time serviceability. It contains no starting brushes or contacts of any kind, and cannot produce sparks, either starting or running. It is thus entirely safe in the presence of inflammable vapors.

Ring to cone pressure is automatically adjusted. The chuck accommodates ¼ inch rods or tubes which may be elevated without interference by the motor. An integral support rod is provided.

Maximum power consumption, 50 watts. Net weight, approximately 7 lbs.

S-76445 STIRRING MOTOR—Sargent Cone Drive, Silent, Variable Speed. Complete with cross support rod, connecting cord and plug with line switch for connection to standard outlets, but without stirring rods or support. For operation from 115 volt, 50 or 60 cycle A.C. circuits $65.00

S-76465 Ditto. But for operation from 230 volt, 50 or 60 cycle A.C. circuits $75.00

SARGENT

NEW SARGENT CATALOG NOW AVAILABLE

SCIENTIFIC LABORATORY INSTRUMENTS · APPARATUS · SUPPLIES · CHEMICALS
E. H. SARGENT & COMPANY, 4647 W. FOSTER AVE., CHICAGO 30, ILLINOIS
MICHIGAN DIVISION, 1959 EAST JEFFERSON STREET, DETROIT 7, MICHIGAN
SOUTHWESTERN DIVISION, 5915 PEELER STREET, DALLAS 9, TEXAS

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nounced by The George Scherr Co. One is a roller thread pitch diameter comparator gage and the other a dial thread plug gage for checking internal threads. Both instruments are designed for quick inspection by unskilled operators. The roller thread pitch diameter comparator gage has an indicator gage reading in 0.0001 in. and is set by means of a master thread gage. The dial thread plug gage measures internal threads quickly by means of three interchangeable measuring jaws, of which the middle one is retractable between the other two. Illustrated circular can be obtained from the company.
George Scherr Co., 200 Lafayette St., New York 12, N. Y.

INSTRUMENT COMPANY NEWS

The Babcock & Wilcox Co., New York, N. Y.—It has been announced that preparation and distribution of news releases for the company will be handled through its Public Relations Dept. after Dec. 15, 1953. Roy Quinn, Director of Public Relations, should be contacted about news at his office address, 161 E. 42nd St., New York 17, N. Y.

Electric Storage Battery Co., Philadelphia, Pa.—Promotion of three executives has been announced by Roland Whitehurst, vice-president and manager of industrial products division. C. J. Moore, former manager of railway and motive power sales, becomes industrial products sales manager; W. E. Nyce has been appointed manufacturing manager, industrial products; and L. E. Wells, former chief engineer, has been named director of research and engineering, industrial products.

Hallikainen Instruments, Berkeley, Calif.—K. E. Hallikainen announces the appointment of the following manufacturers' representatives to handle the sale of company products for the states of New York, Connecticut, Pennsylvania, Delaware, and New Jersey: Louis M. Hachenberg, P. O. Box 103, Wood-Ridge, N. J.; and for the states of Illinois, Michigan, Iowa, Indiana, and Wisconsin: A & A Instrument Co., 608 S. Dearborn Ave., Chicago 5, Ill.

Helipot Corp., South Pasadena, Calif.—Appointment of David C. McNeely as sales manager of Helipot Corp. has been announced by Donald C. Duncan, general manager. Mr. McNeely was sales manager of the Philadelphia Gear Works for the past three years. Previously, he was manager of distributor sales for the Morse Chain Co. of Detroit.

Helipot Corp., South Pasadena, Calif.—The company held open house on December 3 to celebrate the inauguration of its new eastern plant in Mountainside, N. J. The new plant provides 14,000 sq ft of space and manufacturing facilities.

North American Philips Co., Inc., Mount Vernon, N. Y.—According to a company announcement, *Aviation Age*, national trade publication, has presented its December Award to the Electronics Div. for outstanding design in the development of the company's new miniaturized radio compass control panel. The device, which Philips recently made available to the aircraft industry, is exactly half the size of previous units of this type and lighter in weight.

Radio Corp. of America, Camden, N. J.—Walter A. Buck, vice-president and general manager of the RCA Victor Div., recently announced that construction has been started on a group of buildings to serve as administration and laboratory headquarters for the Home Instrument and Service Co. activities. The project scheduled for completion in the fall of 1954, will be located in the suburban Cherry Hill section of Camden. The five interconnected buildings will provide 325,000 sq ft of space and will house 1400 persons.

Calendar of Other Societies' Events

"Long" and "short" calendars will appear in alternate BULLETINS. The "short" calendar notes meetings in the few immediate weeks ahead—the "long" calendar for months ahead.

American Society of Heating and Ventilating Engineers—Jan. 25–27, 60th Annual Meeting, Rice Hotel, Houston, Tex.

Institute of Aeronautical Sciences—Jan. 25–29, Annual Meeting, New York, N. Y.

Society of Plastics Engineers, Inc.—Jan. 27–29, Tenth Annual Technical Conference, Royal York Hotel, Toronto, Ontario, Canada.

Society of the Plastics Industry, Inc.—Feb. 3–5, Ninth Annual Reinforced Plastics Division Conference, Chicago, Ill.

American Society for Quality Control—Feb. 5–6, Middle Atlantic Regional Conference, Baltimore, Md.

National Concrete Masonry Association—Feb. 7–10, 34th Annual Convention, Shoreham Hotel, Washington, D. C.

American Institute of Mining & Metallurgical Engineers—Feb. 14–18, Annual Meeting, Statler Hotel, New York, N. Y.

American Concrete Institute—Feb. 22–25, Annual Convention, Shirley-Savoy Hotel, Denver, Colo.

American Concrete Pipe Association—Feb. 25–27, 46th Annual Convention, Fairmont Hotel, San Francisco, Calif.

Society of Automotive Engineers—March 2–4, Passenger Car, Body and Materials Meeting, Detroit, Mich.

National Electrical Manufacturers Association—March 7–11, Winter Meeting, Chicago, Ill.

American Institute of Chemical Engineers—March 8–10, Statler Hotel, Washington, D. C.

American Foundrymen's Society—March 8–14, Annual Convention, Cleveland, Ohio.

American Society of Mechanical Engineers—March 10–12, International Meeting, Mexico City, D. F.

American Railway Engineering Association—March 13–16, 1954, Convention, Palmer House, Chicago, Ill.

National Association of Corrosion Engineers—March 15–19, Annual Conference and Exhibition, Municipal Auditorium, Kansas City, Mo.

Steel Founders Society—March 16–17, Annual Meeting, Chicago, Ill.

American Chemical Society—March 24—April 1, Spring Meeting, Kansas City, Mo.

National Petroleum Association—April 14–16, 51st Semi-annual meeting, Cleveland Hotel, Cleveland, Ohio.

Metal Powder Association—April 26–28, Annual Meeting, Chicago, Ill.

The Behavior of Aluminium Alloy Riveted Joints

Report No. 15, Aluminium Development Assn., 33 Grosvenor St., London W.1, 100 pp., 7/6d.

The increasing use of aluminum in structural work has made the information found in this pamphlet of growing importance, and its value is emphasized by the tendency hitherto of designers, lacking the full data, to apply to aluminum the standard practices for steel despite differences in the mechanical properties and riveting techniques of the two metals.

The Association feels this Report to be an important contribution to the subject. It is believed that the present work, though not directly concerned with behavior of joints under fatigue, will provide helpful information for interpreting results of repeated load tests.